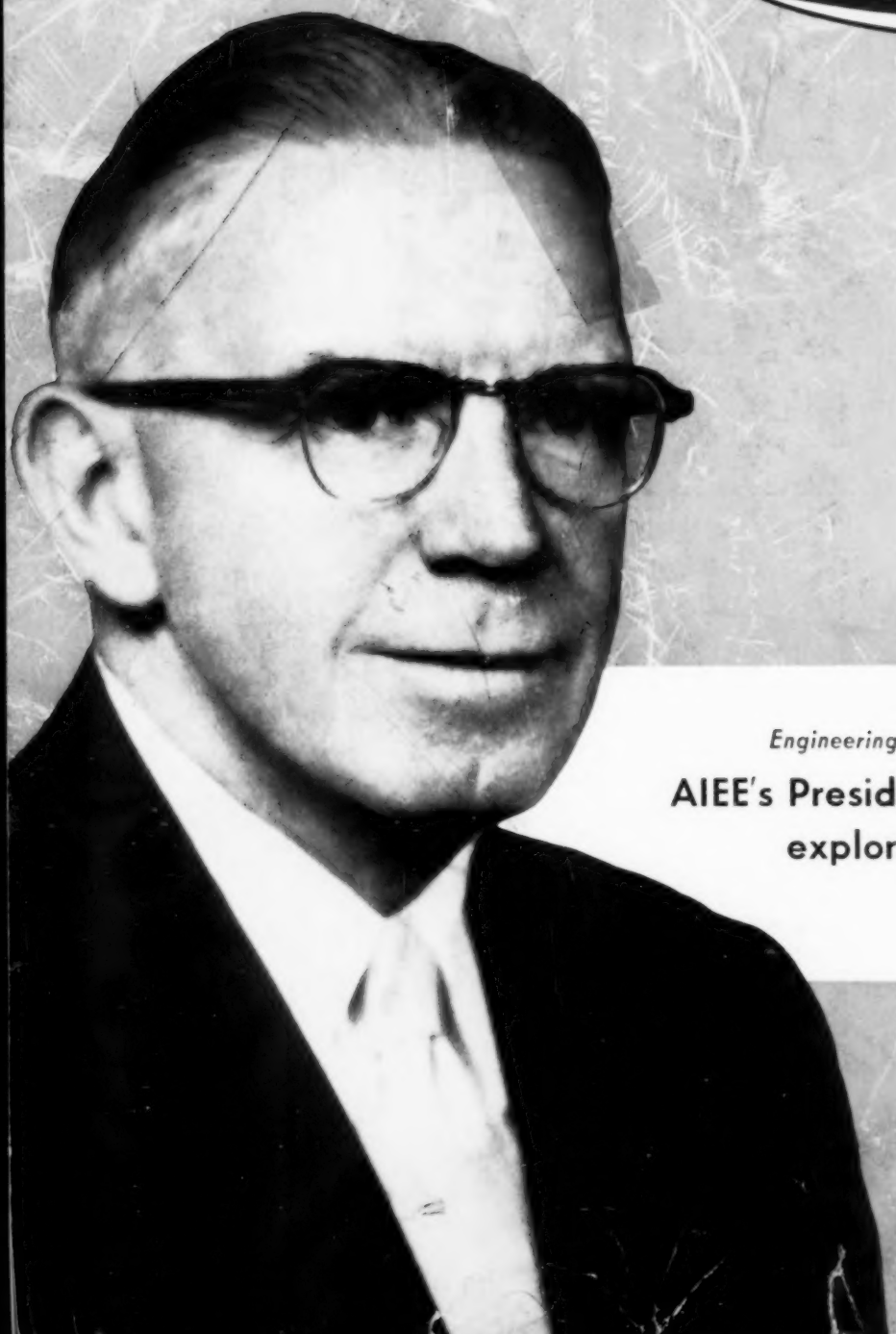
JANUARY, 1958

Financing the Future for Utilities page 18

Economy in a Whisper page 22

POWER INDUSTRY



Engineering societies ineffective? Should they unify?

AIEE's President WALTER J. BARRETT explores UNITY for ENGINEERS

page 15

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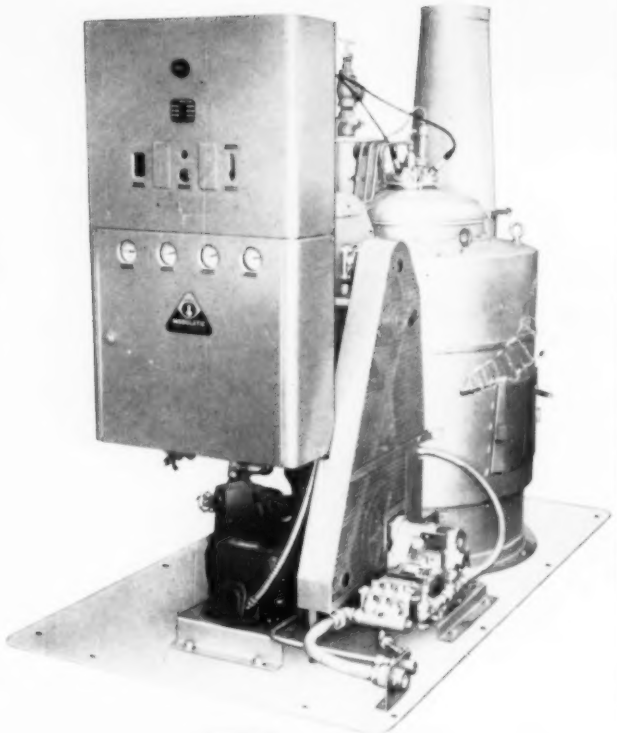

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Jan. 20-24: AIEE Winter General Meeting; Statler and Sheraton-McAlpin Hotels, New York City.
Jan. 27-29: ASHAE Annual Meeting; Penn-Sheraton Hotel, Pittsburgh.
Jan. 27-30: Plant Maintenance & Engineering Show; International Amphitheatre, Chicago.
Jan. 30-31: American Society for Engineering Education College-Industry Conference; University of Michigan, Ann Arbor.
Feb. 2-7: AIEE Winter General Meeting; Statler Hotel, New York City.
Feb. 3-4: ISA Conference on Chemical and Petroleum Instrumentation; Wilmington, Del.
Feb. 3-6: National Industrial Electric Heating Conference; Netherland Hilton Hotel, Cincinnati.
Feb. 3-15: College of Business and Public Service Program on Administration for Experienced Executives; Michigan State University, East Lansing.
Feb. 16-20: AIME Annual Meeting; Statler and Sheraton-McAlpin Hotels, New York City.
Feb. 17-20: Industrial Ventilation Conference; Michigan State University, East Lansing.
Feb. 24-28: ASCE Annual Meeting; Hotel Sherman, Chicago.
Feb. 24-*March* 8: American Society for Engineering Education College-Industry Conference; University of Michigan, Ann Arbor.
March 2-6: ASME Power Division Gas Turbine Conference and Exhibit; Shoreham Hotel, Washington.
March 10-11: ASME Lubrication Division Symposium; 150 East 42nd St., New York City.
March 19-20: ASME Management Conference; Boston.

Circle 1400 opposite last page.

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JANUARY 1958

VOL. 74 NO. 1

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AIEE President Walter J. Barrett points out how some of the engineering organizations have grown until their functions overlap. He explores the possibility of a single supra-organization under NSPE.

18 **Financing the Future for Utilities**

Charles E. Oakes, President of Pennsylvania Power & Light, examines the problem of meeting 1970's estimated demand of 310 million kilowatts.

22 **Economy in a Whisper**

How do you heat and provide hot water for a 2500-student high school when the boiler room is adjacent to classrooms? Chief Engineer Edgar A. Burt of Massapequa High School explains how it was done.

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20 **Air Conditioning with Package Units**

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RAMBLINGS ON INSTRUMENTATION

The Hays Menu of Combustion Guides

Wherever fuel is burned in any quantities, it makes good economic sense to invest in an instrument to continuously indicate and/or record combustion efficiency—that is, a combustion guide. Hays offers the most complete line of such instruments including:

1. The Magno-Therm Oxygen Analyzer
2. The Boiler Efficiency Meter or Air-Flow/Steam-Flow Meter
3. The Combustion Meter or Automatic Orsat
4. The Condu-Therm CO_2 Analyzer, an all electronic thermal conductivity measuring instrument

This month we'd like to describe the merits of:

Item 1—Oxygen on the Half Cell or La Pièce de Paramagnetic

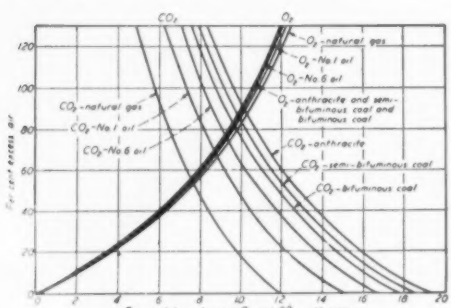
This fine product has been affectionately nicknamed the Hays Magno-Therm Oxygen Analyzer. It is, to put it flatly, the most widely accepted industrial type oxygen analyzer currently in production in the U.S.

Its operation is based on the exceptional paramagnetic property of oxygen, a quality not found in other commonly used industrial gases. No sample preparation is required other than nominal filtering and cooling. Its analyzing cell is inert, needs no electrode replacements and requires no fuel supply.

Ranges vary from a minimum of 0-5% to a maximum of 0-100%, with suppressed zero ranges of a minimum 5% anywhere in the spectrum. For example: 17 to 22% for analyzing the oxygen in smoke-filled rooms.

Some of the advantages of the Hays analyzer include high degree of sensitivity, rapid response, and almost monotonous accuracy.

O_2 analysis is particularly handy when switching from one fuel to another or burning more than one fuel at the same time. Why? Because oxygen and oxygen alone gives you an undistorted picture of the amount of excess air present in combustion gases. This fact is borne out by the graph below showing the relationship of excess air to CO_2 and O_2 in the flue gas of five common fuels. While the O_2 curves nearly coincide (especially in the important 30% excess air range) the CO_2 curves diverge widely. With any other type of combustion guide, you would have to re-calibrate for each fuel (when switching from one to another) or put up with extremely unreliable information (when burning multiple fuels).



Note uniformity of O_2 compared to CO_2, burning fuels of varying hydrogen/carbon ratios. (Write for detailed chart, 8½x11" in one glorious color, suitable for framing.)

We have a rather fascinating tome entitled "Combustion and Combustion Guides" which goes into this sort of thing in elaborate detail. If you'd like a copy, address your request to my personal attention and I will send you one promptly.

Phil Sprague Jr.

President

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Circle 1401 opposite last page.

NEWS IN BRIEF

The engineer's plight:

Is money everything?

Salaries for engineers, scientists, and administrative personnel rose only 5.9% in last fiscal year, according to American Management Association survey. Previous fiscal year registered 8.6% salary rise. Greatest rise within the group studied was for quality control engineers, who averaged 7.9%. Smallest rise was for systems and procedures analysts, who average 3.8%.

Meanwhile, back at the National Association of Manufacturers, a supplement to "Satisfying the Salaried Employed" has been issued to help management retain white collar worker's loyalty.

NAM warns that if industry doesn't deal with white collar worker's problems, organized labor will. (See PI's Engineering Shortage Survey, October 1957.)

SAC: in glorious color

Compatible closed-circuit color television installed by Radio Corporation of America in Strategic Air Command's new underground headquarters near Omaha brings SAC's internal communications system to top speed.

System eliminates need for many group meetings and much mass data duplication. Briefing, intelligence, and weather colorcasts will be part of daily routine.

Switching equipment permits control room operator to feed any combination of five incoming signals to any combination of receiver locations. Intercommunication system permits two-way conversation between personnel at camera and receiver locations.

Real sharp

Flame-plated skiving knife cuts and slices rubber up to 40 times longer between sharpenings than unplated knife. Linde Co. uses a flame-plating process that blasts tungsten carbide particles onto blade knife to a thickness of 0.002 inches. Unplated knife cuts about 6 miles of rubber between sharpenings.

Up aluminum conductors to 62% conductivity

Aluminum Company of America announces new aluminum conductor with a minimum conductivity of 62% without reducing tensile strength.

Present industry standard is 61% (International Annealed Copper Standard). Percentage increase could enable engineers to assign a present worth cost-saving of as much as 2c/lb of conductor in transmission losses. New measure is available in redraw rod and EC grade conductor.

Big orders in the news

Westinghouse Electric Corp. will build a 100,000-kw turbogenerator for the Public Service Co. of New Hampshire. Included in $4-million contract are condenser and electric equipment for Public Service's new power station north of Manchester.

Allis-Chalmers Manufacturing Co. and S. Morgan Smith Co. will build 12 pump-turbines for Niagara Power Project's Tuscarora plant. Units will cost over $11 million.

Babcock & Wilcox Co. is shipping boiler parts to Tokyo

for Tokyo Electric Power Co.'s Chiba Thermal Power Station. Assembled boiler will have 1.3 million lb/hr capacity, highest of any boiler exported by B&W. B&W is also furnishing steam drum, superheaters, and small parts for boiler being built by Babcock-Hitachi, also for Japan's Chiba Thermal Power Station.

Molten metals float

Levitation melting, developed by Westinghouse Research Laboratories and the University of British Columbia, permits metals and alloys to be prepared for research without danger of chemical reaction from impurities picked up from containing vessel.

System places compressed metal powder inside copper

To 5000°F in 30 seconds

coil carrying a high-frequency electric current. Eddy currents keep metal powder suspended inside the coil. Temperatures go to 5000°F in half a minute to melt the metal. Process is carried out inside a sealed vessel filled with inert gas to protect pure metal from contamination.

Water, water everywhere: is it safe to drink?

Michigan State University scientists and researchers, in probing health hazards traceable to common viruses, point an accusing finger at two possible carriers: drinking fountains and municipal and industrial sewage plants.

Since every virus particle is a potential infection source, drinking fountains and surrounding air could be re-con-

→ to next page

Now! Test for Filming Amine Content in Minutes with New $29.50 Dearborn Kit

Now you can test for active filming amine (octadecylamine) residual in steam condensate...quickly, accurately and inexpensively.

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Dearborn Test Kit consists of Extraction and Color Comparison Tube, Distilled Water Ampoule, Permanent Color Standards, Comparator Block and necessary solutions. Complete price: $29.50.

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Circle 1402 opposite last page.

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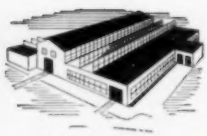
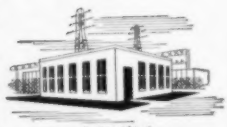
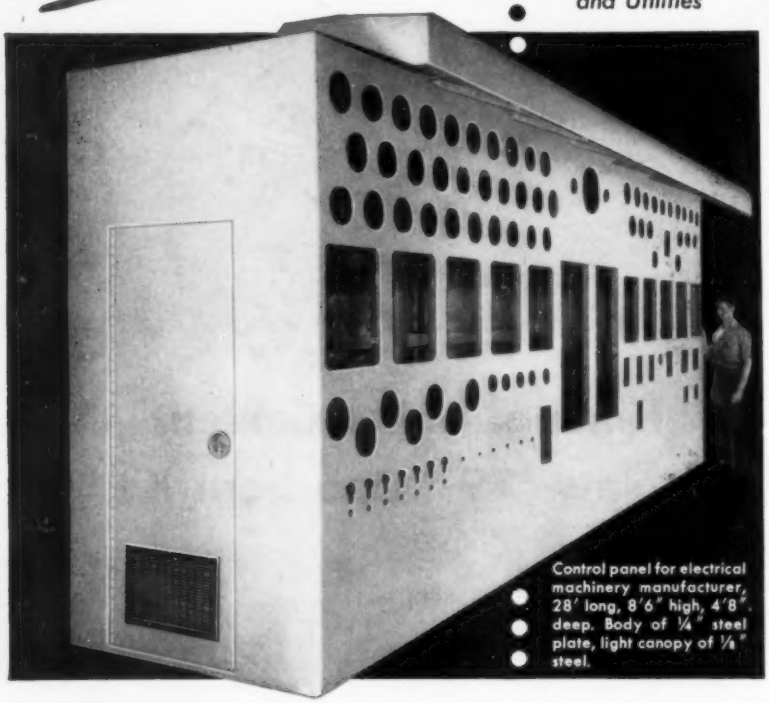


For Industry

Power Plants



and Utilities



Control panel for electrical machinery manufacturer, 28' long, 8'6" high, 4'8" deep. Body of ¼" steel plate, light canopy of ⅛" steel.

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METAL FABRICATION

Circle 1403 opposite last page.

NEWS IN BRIEF

← *from preceding page*

taminated every time a person takes a drink. Virus particles have been found 4 feet from drinking fountain 30 minutes after putting test virus in water.

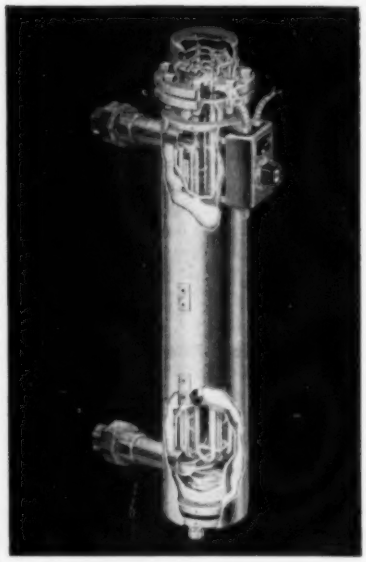
Sewage tests at disposal plants in Lansing and East Lansing over the last two years show that virus and bacteria are being dumped back into the river after going through activated sludge-type disposal systems.

Apparently industrial wastes destroy some virus — samples from sewage in East Lansing's residential area had more virus than samples from industrialized city of Lansing, although Lansing's population is double East Lansing's.

1958 coal use to sink below '57, '56 levels

Bituminous coal production for the January-March quarter 1958 will be about 121 million tons — 5.2 million tons under 1957 consumption for the same period, and also lower than 1956 consumption. Four-year average consumption for January-March quarter is 115.3 million tons.

"I'd like you to break it gently to the other elves."



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Circle 1404 opposite last page.

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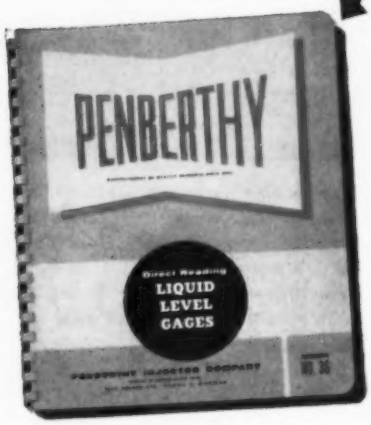

Shows complete line of Penberthy valves and liquid-level gages for power, petroleum, and process industries. Includes technical data, parts, price lists, and accessories such as:

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ILLUMINATORS... plastic wedge distributes bright, even light along entire column. Nonglaring... dustproof for perfect illumination.

WELDING PAD GAGES... where process conditions require observation windows as integral part of vessel.

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COMPANY_____

Circle 1405 opposite last page.

Washington County — it's a gasser

Washington County, Miss., is crossroads for pipelines carrying natural gas from Texas and Louisiana to Great Lakes and New England industrial areas. Gas company representatives estimate more gas passes through Washington County than any other single place in the U.S.A.

Award atomic contract on merchant ship

Dept. of Commerce Maritime Administration and the Atomic Energy Commission award contract for the NS Savannah, world's first nuclear-powered merchant ship, to the New York Shipbuilding Corp.

Nuclear propulsion system will be furnished by Babcock & Wilcox Co. under a separate contract. Construction schedule calls for keel-laying in 1958, launching in 1959, and full intercontinental operation by 1960.

Florida Power orders two turbogenerators

Florida Power and Light Co. has ordered two 240,000-kw turbogenerators from Westinghouse Electric Corp. New additions will make FP&L's generating capacity 108% higher than in 1956. New units will be installed at new plant site near Port Everglades, Fla.

Corrosion engineers: industry needs you

John Halbig Armco Steel Corp., speaking at the AIChE Annual Meeting, emphasized need of every large industrial plant for at least one corrosion engineer on its staff.

According to Halbig, part of corrosion engineer's job would be to keep up with developments in corrosion field. Plant engineering staffs are often hampered by lack of current knowledge and developments.

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just say

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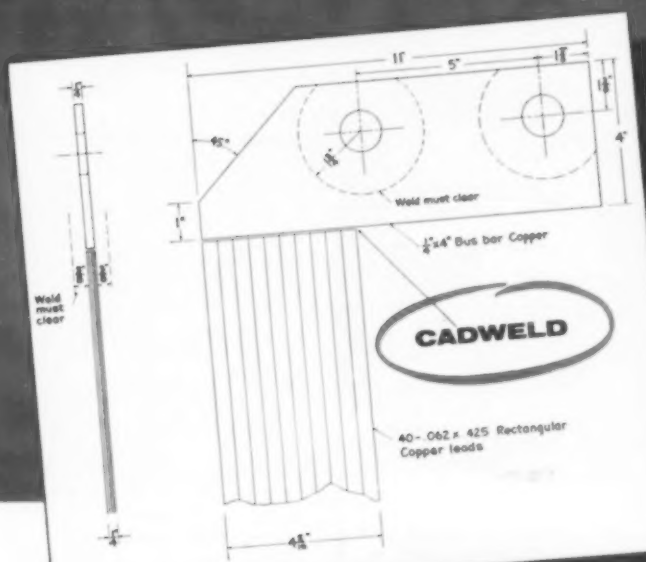

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Circle 1407 opposite last page.

NEWS IN BRIEF

← *from preceding page*

Silicon cells go solar

Silicon solar battery cells can power portable devices that normally operate on storage or dry cell batteries. With their ability to convert light and radiant energy into electric power, these tiny p-n junction-type cells will be a boon at sea or in wilderness areas. International Rectifier Corp. is the developer.

Linear polyethylene — Dow will make it

Dow Chemical Co. is constructing new plant in Bay City, Mich., to produce linear polyethylene — a plastic differing from high-pressure polyethylene because of its greater resistance to heat, chemicals, and vapor transmission and because of its increased toughness and rigidity.

Raw materials will come from Dow's petrochemical group and from its wholly owned subsidiary, Bay Refining Corp.

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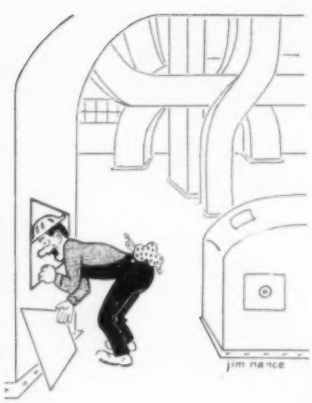

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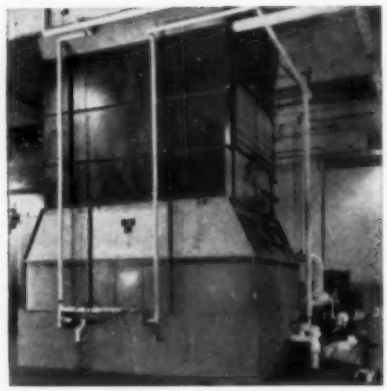

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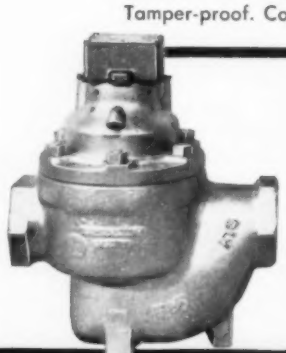


FAMOUS HENSZEY VORTEX-TYPE METER
A rugged, heavy duty meter adaptable for many liquids. Measures with extreme accuracy regardless of the liquid's temperature or gravity.

HENSZEY

HENSZEY COMPANY · Dept. A · Watertown, Wis.

Circle 1409 opposite last page.

It's time we got together . . .

What makes a Mechanical engineer different from an Electrical, Civil, Chemical, or Metallurgical engineer? It is doubtful that any drastic changes occur in the bodily composition of an engineer as a result of prolonged exposure to thermodynamics, calculus, hydraulics, or qualitative analysis.

Certainly, all engineers are human and must recognize that they have many common interests in their fight for professional recognition. Why then, should each field be represented by a relatively small group from that field? Isn't this asking for narrow society policies with little interchange of ideas? No wonder the issues are confused.

Many engineers graduating today are receiving degrees in more than one field. Modern technological developments often require that an engineer work with electrical as well as mechanical problems with equal ease. Should these men join the ASME, the AIEE, or both?

Obviously, the engineering profession would have a much better chance of influencing public opinion if the Societies would amalgamate into one functional organization to represent all engineers. The new United Engineering Center is a step in the right direction. Let's follow this move with a real effort to have a single nonconflicting organization to be spokesman for the entire engineering profession.

The San Francisco proposal, promulgated in 1956, clarifies the division of responsibilities and outlines how this amalgamation can be accomplished. Instead of following the "red-tape" confusion of governmental rule, the engineering profession should be leaders in efficient organization. These steps must be taken soon . . . .

- Open NSPE membership to unregistered engineers who hold suitable grades of membership in the founder societies
- Make a concerted effort to promote interest in and to formulate a single unified engineering organization.

The future is up to you — like government, you get what you deserve. Think about it now, while you are reading this article. Let your voice be heard. Bring this subject up at your next district society meeting. Discuss it — go on record as taking a definite stand on this matter. Let this stand be known to your Society's National headquarters.

Only in this way will engineers attain professional recognition and induce high school students to follow engineering. We are behind in the race for technological supremacy now — don't let lethargy or mental inertia drag us farther behind.

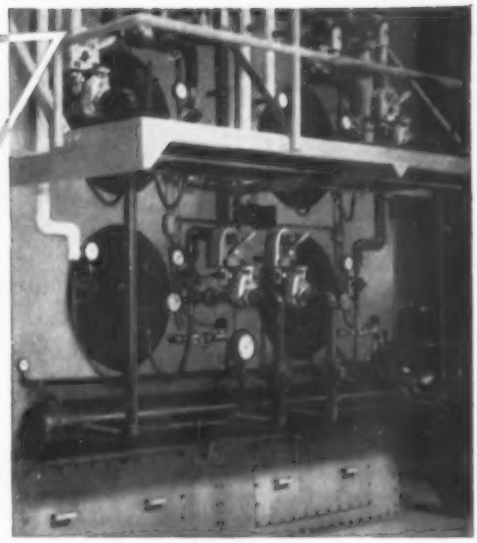
We have brought this to your attention. The rest is up to you.

Robert W DeMoss

Robert W. DeMoss
Associate Editor

ENCO BURNERS FOR OIL, GAS OR TAR

Steam Or Mechanical Atomizing 1 TO 1000 GALLONS PER HOUR



Designed for operation with either gas, oil or both with natural or forced draft. They can be depended on for maximum combustion efficiency.

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ENCO Oil Atomizers are applied to various types of standard pulverized-coal and gas-burner units cold starting or for full load operation when coal or gas is not available, or when oil is the more economical fuel.

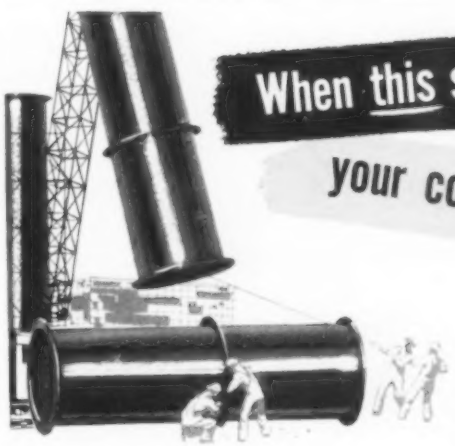
Send for Bulletin OB-53 describing ENCO Gas and Oil Burners, also complete Pumping and Heating Units.

EC 811

THE ENGINEER COMPANY, 75 West Street, New York 6, N. Y.

Circle 1410 opposite last page.

When this stack goes up your costs go down



A. O. Smith *Permaglas*® smokestacks—glass-protected inside and out . . . are virtually impervious to condensate corrosion

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Circle 1411 opposite last page.

One of a series.

Some Things to Think About Steam Traps

...in order to get high operating efficiency and a minimum of maintenance

The gentleman who invented the wheel had a basic idea and so far no one has come up with anything better for the purpose.

If you'll pardon us for a little overemphasis on the significance of steam traps, we'd like to liken one of them to the wheel.

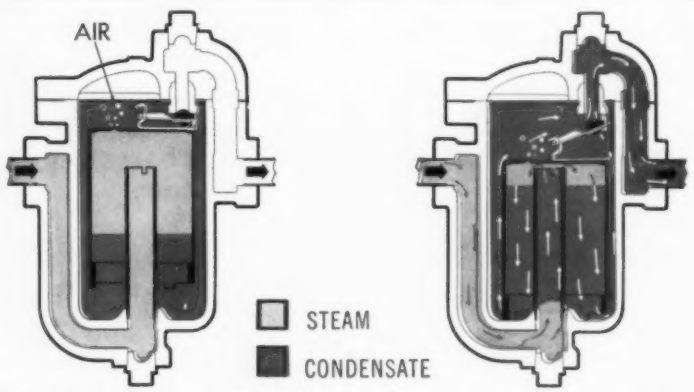
In 1911, when the first Armstrong inverted bucket steam trap model was announced to the world, or at least that part of the world that modest advertising and sales budgets would cover, it was not received with equal enthusiasm by all (especially old-style trap makers). But, like the wheel, it managed to find its way into general use. And, nothing better has ever turned up for the purpose of draining condensate. As a matter of fact, the Armstrong trap has been very widely copied. Today, there are more inverted bucket traps draining process equipment than any other kind. Of these, there are more Armstrongs.

If this sounds like the boasting of a proud parent, give consideration to some fundamental requirements not met by all traps:

1. ***A steam trap should not leak steam.*** Some traps do, you know, because of the nature of their operating principle. No steam ever gets to the Armstrong trap orifice. The valve is always water sealed.

2. ***A steam trap should vent "air" as fast as it accumulates***—otherwise temperatures are reduced and corrosion is a problem. The Armstrong trap handles air very nicely. The vent in the bucket permits air to accumulate in the top of the trap, from where it is discharged when the trap opens. For extreme conditions like draining paper machine dryers, some jacketed kettles and certain other [illegible], the vent is sized larger for [illegible]ob. And, for handling big volumes of air during warm-up, a [illegible] with an auxiliary thermic [illegible]ally speeds up heating.

3. ***A steam trap should discharge condensate at steam temperature*** if you want to get maximum efficiency from the unit drained. And most people certainly do. If you have to wait for the condensate to cool, it's almost impossible to maintain maximum temperatures and prevent air build-up. You guessed it—the Armstrong trap opens for water, without dependence on temperature.



Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

4. ***A steam trap should be suitable for any return system.*** The Armstrong trap works just the same whether discharging to atmosphere, back pressure or vacuum. It has been conclusively proved that flash steam resulting from use of a bucket trap does not cause a problem in vacuum return systems. The flash condenses rapidly. It's the leaky traps that cause the headaches.

5. ***A steam trap should not be a "prima donna".*** Some kinds of traps take an awful lot of care and coddling. The Armstrong trap is a rough and ready type with a hardened chrome steel constitution (valve and seat, to be exact). It cleans itself of ordinary dirt and scale without choking up. Its 18-8 stainless parts stave off rust and corrosion. It resists wire-drawing and wear remarkably well. In fact, it stays on the job longer with less attention than any trap ever produced. Unless you live in Siberia, you can probably find a user around the corner who will tell you so from experience.

6. ***A trap should not be an "orphan".*** With Armstrong traps you can *always* get prompt service and parts from nearby Factory Representatives and stocking distributors as well as from the factory.

7. ***A trap should have a guarantee.*** The Armstrong trap is unconditionally guaranteed to give you *complete satisfaction* (as to doing its job, that is). If it doesn't, you can get your money back.

If you'd like to buy some of these excellent steam traps, call your local Armstrong Representative or write **Armstrong Machine Works, 8201 Maple St., Three Rivers, Michigan.**

ASK FOR the 44-page Steam Trap Book, free on request without obligation.

ARMSTRONG STEAM TRAPS

Circle 1412 opposite last page.

NEWS IN BRIEF
← *from page 8*

New group to design nuclear power plant

American Nuclear Power Associates will sponsor design of radically new high-temperature nuclear power plant hoped to point the way to economically competitive nuclear power.

Plant will be based on Raytheon Manufacturing Co.'s liquid-metal fuel gas-cooled reactor concept, with group's engineering team working at Raytheon research laboratories. Besides Raytheon, group members are Burns and Roe, Inc.; Clark Bros. Co.; Griscom-Russell Co.; and Rockland Light and Power Co.

Souped-up golf balls

Golf balls treated with gamma rays give longer driving distances and have tougher covers, according to B. F. Goodrich Co. Less than two-minutes' exposure to the rays results in a tougher ball. Treated balls do not become radioactive, look just like conventional balls.

"There's the trouble with today's youngsters—they don't drill them enough in basic arithmetic."

ALCO Products to build sodium heat exchangers

ALCO Products, Inc. will build three intermediate sodium heat exchangers for the Enrico Fermi nuclear electric generating station, Detroit.

Station is being built by Power Reactor Development Co. from Atomic Power Development Associates design. Heat exchangers will incorporate features first used in units made by ALCO for the Nautilus.

High taxes, labor bring inflation — not profits

National Assn. of Manufacturers, in a new study of industry wage, price, profit trends, deny labor charges of greed.

According to NAM, inflationary trend is caused by rising labor costs and continuing heavy taxes. Manufacturers' profits from sales dropped from 4.9% in 1948 to 3.1% in 1956, to hit a low normally associated with recession years.

Analog computer center to open in February

First US high-precision analog computer center opens in February in New York City. Manhattan Computer Center, to be operated by Mid-Century Instruments Corp., will have latest computer equipment and 136 amplifiers.

Cost is $28.50/hr for 48 amplifiers to charter subscribers. Center will be open 24 hours a day seven days a week.

World's biggest belt

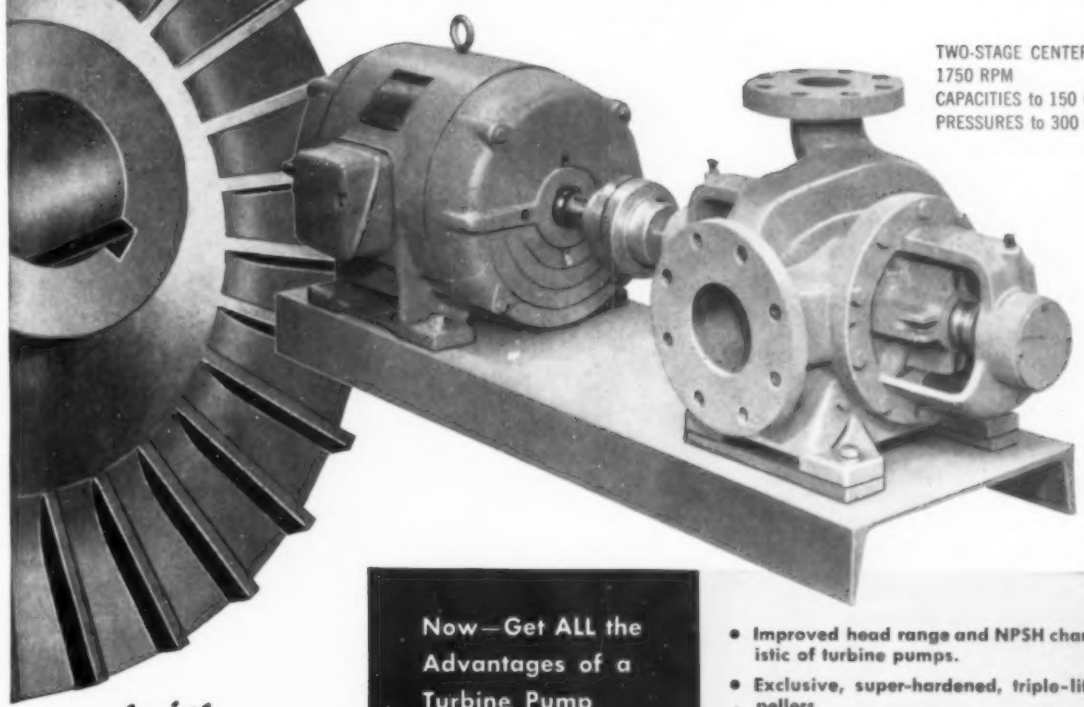
Manhattan Rubber Div., Raybestos-Manhattan, Inc. is shipping what is believed to be the world's largest one-piece conveyor belt.

Belt, measuring 2940 feet long, is destined for a coal mine. Wound on a reel about 13 ft diam, belt is being shipped on special low-bed gondola car to clear overpasses and tunnels. ◆

announcing

the most durably engineered turbine type pump yet built . . .

the NEW SCHAUB POWER PLANT Boiler Feed Pump



TWO-STAGE CENTER MOUNTED
1750 RPM
CAPACITIES to 150 GPM
PRESSURES to 300 PSI

Now—Get ALL the Advantages of a Turbine Pump —WITH TWICE THE PUMP LIFE!

- Improved head range and NPSH characteristic of turbine pumps.
- Exclusive, super-hardened, triple-life impellers.
- New "over-strength" case, shafting and bearings.
- Less maintenance, easier servicing.

Exclusive
DuraHard® Electrolized Impellers

A super-hard (1100 Brinnel) "skin" of dense, non-magnetic alloy resists wear, corrosion and erosion. Will not chip, peel or spall. When, or if it eventually wears through, the base metal in its original dimension still has normal service expectancy! Electrolizing also relieves impeller of stresses set up during forming and machining . . . Increases impeller life up to 300%.

Now, for the first time, you can specify or design a boiler feed system offering the advantages and better head characteristics of the turbine pump — *and get maximum pump life, too!*

The new Schaub Power Plant Pumps are "over-strength" in all components. Double-row, pre-lubricated ball bearings are oversize for a wider margin of safety. Newly improved Schaub Flexi-matic Seals permanently end packing problems, scored shafts, lubrication wash-out and seal leaks. Heavy-duty housing and bearing arms keep pumps "in line" and prevent warpage. Low stuffing box pressure doubles shaft seal life.

In short, we believe that in Schaub Power Plant Pumps you now have available to you the most trouble-free turbine pump ever built! Even its minimum maintenance needs have been made easier, quicker . . . and inexpensive.

Schaub Power Plant Pumps are one more good reason for specifying Schaub Boiler Feed Systems. *It will also pay you to specify them for individual pumps and replacements.*

WRITE FOR NEW BULLETIN No. 65 ● Get the full facts on this new major break-through in turbine pump design. Technical data, pump "lore", specifications, dimensions and capacity ratings. A must for consulting and power engineers.

FRED H. SCHAUB ENGINEERING COMPANY
2115 S. Marshall Boulevard, Chicago 23, Illinois

Circle 1413 opposite last page.

SPOTLIGHT ON . . .

PEOPLE

General Electric Co. vice president **William V. O'Brien** is new **National Electrical Manufacturers Association** president. O'Brien is manager of GE's Apparatus Sales Division.

E. B. Pool is promoted to chief research engineer at **Edward Valves, Inc.** Other key promotions: **Wilbert G. Hegener** to research and engineering coordinator and **Harold N. Myers** to research metallurgist.

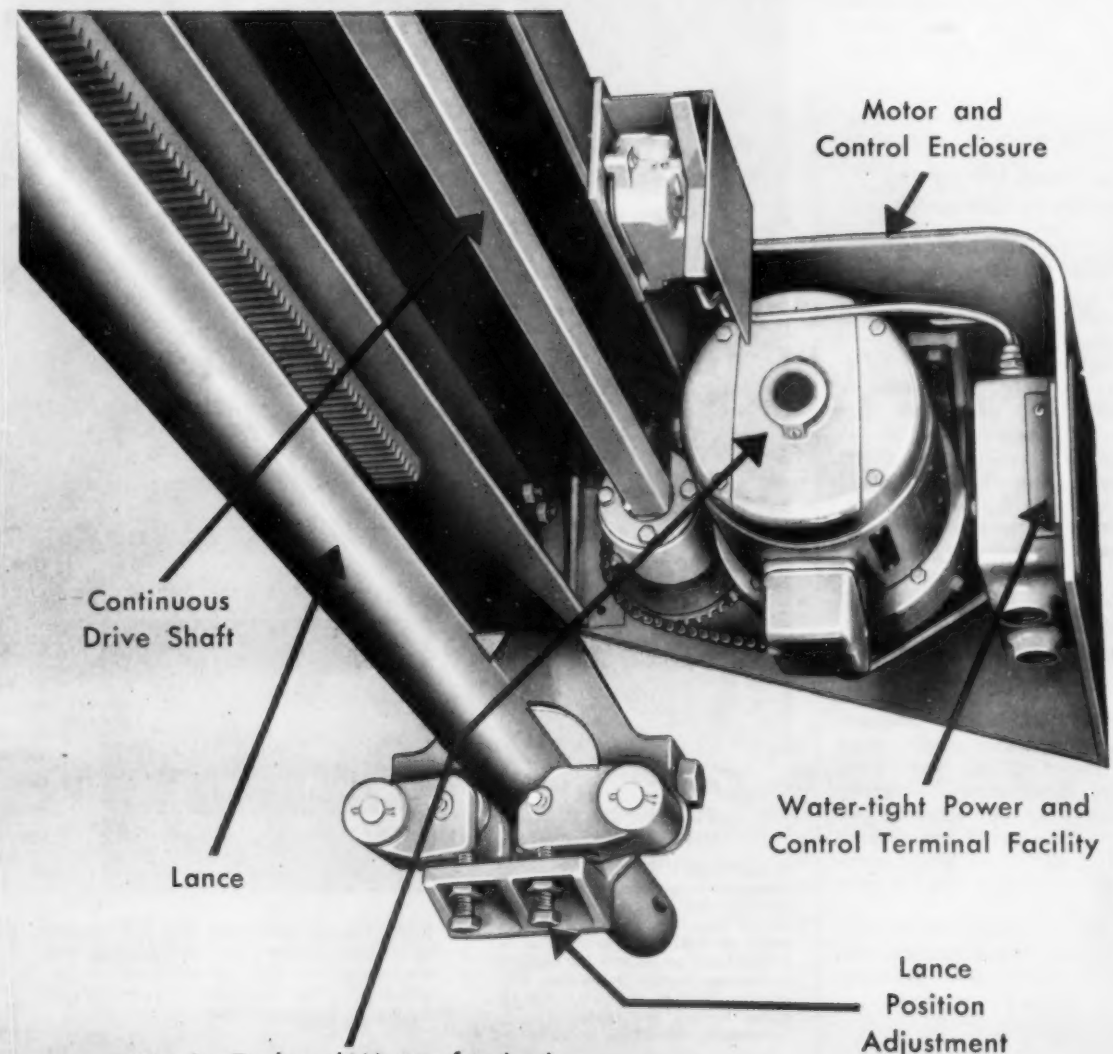
American Standards Association makes two outstanding awards. **Roger E. Gay,** former **Bristol Brass Corp.** president, receives the Howard Coonley Medal for "great service in advancing the national economy through voluntary standards." Standards Medal goes to **John Robert Townsend,** special assistant to the Assistant Secretary of Defense. Medal is given for leadership in standards development and application.

Dr. Ernest O. Lawrence receives **Atomic Energy Commission's** Enrico Fermi Award, given for his work on the cyclotron and his other contributions to atomic energy and nuclear physics. Dr. Lawrence directs the University of California Radiation Laboratory. Award includes medal, citation, and $50,000.

Frank W. Jenks, formerly executive vice president, becomes president of **International Harvester Co.** Retiring **Peter V. Moulder,** who ends a 47-year career at International Harvester.

Iron **Fireman Manufacturing Co.** elects **Lewis J. Cox** president. He was elected vice president in 1951 and promoted to first vice president and chief executive officer in April 1957. ◆

FRONT END



Single Enclosed Motor for both
propulsion and rotation
Motor mounted at boiler end for improved
accessibility and better protection from
physical damage and elements.
(Outboard end motor mounting optional)

Single-Motor DRIVE

another important feature of

New Diamond

Series 300 IK
LONG RETRACTING BLOWER

As illustrated at the left, only one motor is used to simultaneously propel and rotate the lance tube of the new Series 300 IK. The motor is stationary and is mounted at the boiler wall for easier accessibility and greater protection from physical damage and the elements (note the protective enclosure). This front end single-motor drive is simple and dependable. There is only one set of motor elements . . . one set of control elements . . . and one set of power supply facilities to operate and maintain.

Additional important features of the new Series 300 IK are listed in the panel below. Check them and you will understand why this blower is establishing a new standard of efficiency, economy and dependability in cleaning those heating surfaces that require a long retracting blower. For further information about the new Series 300 IK, ask your local Diamond office or write directly to Lancaster for Bulletin 2111 PI.

SERIES 300 IK—LONG RETRACTING BLOWER

OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Backbone and Protective Cover
- Compact, Accessible Electric Power and Control Terminal Facilities
- Nozzle-Sweep-Every-Inch Cleaning Pattern
- Improved "Type A" Nozzle
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

Diamond **DIAMOND POWER SPECIALTY CORPORATION**

LANCASTER, OHIO

Diamond Specialty Limited

Windsor, Ontario

7739

Circle 1414 opposite last page.

SPOTLIGHT ON . . .

GROWTH

expansions

Hagan Chemicals & Controls, Inc. is forming separate Nuclear Power Division to handle application of instruments and controls to nuclear power reactors. C. J. Munter, research engineer at Hagan for 27 years, heads new division. Franklin Michaels, electronics engineer, will assist him.

Harnischfeger Corp. plans to build manufacturing plant at Dubuque, Iowa for its Zip-Lift and Hevi-Lift electric hoists and related equipment.

Westinghouse Electric Corp. is adding 100,000 sq ft to its Air Arm Division facilities to house air-borne electronic systems while they are being evaluated for defense projects.

The Trane Co. is awarding contracts for proposed $1.5-million plant in Clarksville, Tenn. Plant will be used to manufacture central home air-conditioning equipment.

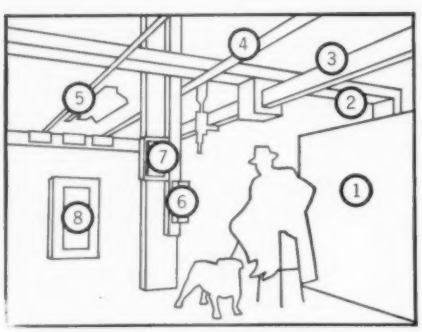
Tube Turns Div., National Cylinder Gas Co. is increasing its manufacturing area by 40% with purchase of buildings on property adjacent to its main plant in Louisville, Ky.

mergers

Waukesha Motor Co., (Waukesha, Wis.) has purchased Climax Engine Manufacturing Co. of Clinton, Iowa. Merger gives Waukesha full line of engines in power range to 1200 hp.

American Machine and Metals has purchased name and certain assets of Rahm Instruments, Inc. and has leased Rahm's Westbury, N. Y. plant and equipment on a long-term basis. Rahm makes electro-mechanical instruments for aircraft and missiles. ◆

Electrical Planning—*key to efficiency and economy, too!*



PLANNED POWER on display—it's yours in a system of coordinated BullDog components. 1. Unit Substation and Unit-Versal® Switchboards. 2. Lo-X® Feeder Duct. 3. Plug-in Duct. 4. Industrial Trol-E-Duct®. 5. Universal Lighting Duct. 6. Pushmatic Electri-Centers®. 7. Clampmatic® Safety Switches. 8. Power Panels.

Score yourself on how well you're using electricity. Is control and distribution of power getting its deserved emphasis in your business? Do you enjoy the benefits of a distribution system tailored to the needs of your operations—whether commercial, institutional or industrial? Such a system, soundly planned by BullDog, can be a giant step toward greater efficiency, profitable use of personnel, and easy, economical growth.

Call on the talents of your BullDog field engineer—let him study your requirements and plan ahead for them. Make sure you are powered up to meet a challenging future. © BEPCO

BULLDOG

BullDog Electric Products Co., Detroit 32, Mich. A Division of I-T-E Circuit Breaker Co.
BullDog Export Division: 13 East 40th St., New York 16, N.Y.
In Canada: BullDog Electric Products Co. (Canada) Ltd., 80 Clayson Rd., Toronto 15, Ont.

Circle 1415 opposite last page.

THAT'S INTERESTING

Snooper — solar spy

Snooper, an ion-propelled rocket engine that could be directed to orbits around the Moon, Mars, or other solar system planets, is up for consideration by the American Rocket Society.

Snooper's developers are Rocketdyne engineers M. I. Willinski and Mrs. E. C. Orr. Unmanned, Snooper would develop thrust through the high-velocity discharge of ionized particles from nuclear fuel.

Sticks Teflon

New adhesive (Ray-Bond-R) developed by Raybestos-Manhattan, Inc. bonds treated Teflon to itself or to wood, steel, glass, aluminum, copper, ceramics, plastics.

Teflon's smooth, waxy surface — normally resistant to adhesives — receives a special treatment that etches surface for bonding. With new bonding technique, Teflon can be used to line tanks, vats, pipes, other vessels, or for insulation.

JANUARY 1958
VOL. 74 NO. 1
POWER INDUSTRY

Unity of the Engineering Profession

By WALTER J. BARRETT
President, American Institute of Electrical Engineers
President, United Engineering Trustees, Inc.

WALTER J. BARRETT, 1957-58 President of AIEE, is a member of the engineering staff of New Jersey Bell Telephone Company. He was previously with American Telephone and Telegraph Company and Ohio Bell Telephone Company.

He graduated from Polytechnic Institute of Brooklyn in 1920 (EE) cum laude. He is a member of the national engineering honor societies, Tau Beta Pi and Eta Kappa Nu.

Mr. Barrett has been a member of the Board of Directors of AIEE since 1949. He was chairman of the finance committee, later treasurer.

Particularly active in the field of intersociety relations, he served several years as a member of the Board of Directors of Engineers Joint Council, and with its executive committee. He has been a member of the Board of Trustees of United Engineering Trustees, Inc., since 1951 and president of that organization since February 1955.

Individual membership "Technical Societies" have been organized at various times, starting with the American Society of Civil Engineers in 1852. There are the joint agencies established by the technical societies. These include United Engineering Trustees, Inc., Engineers' Council for Professional Development, and Engineers Joint Council. Then there is the National Society of Professional Engineers, an individual membership organization, subdivided into state and county units.

United Engineering Trustees, Inc., has clearly defined responsibilities. It owns and administers the Engineering Societies Building, the Engineering Societies Library, and Engineering Foundation.

It is also the repository of certain trust funds held for the benefit of the profession broadly. It is charged with responsibility for providing the new United Engineering Center, for which land has been purchased facing United Nations Plaza.

Engineer's Council for Professional Development is concerned with engineering education and the development of young engineers, as well with the canons of ethics. It is best known for its accrediting of engineering schools.

Engineers Joint Council was originally an informal consulting group composed of secretaries and presidents, and later past-presidents, of five technical societies. The Exploratory Group included representatives of some 15 technical societies, to consider plans for unity of the profession.

The Group recommended that this be accomplished by expanding EJC to take in other societies in all branches of the profession. The addition of other societies to the EJC group has not been rapid.

Role of the EJC

As the matter stands now, Engineers Joint Council has been operating in a number of fields. In addition to such technical matters as national water policy, engineering sciences, and the Nuclear Congress, it has interested itself in education, relations with engineering groups in other countries, recognition of specialties, honors for engineers, the National Engineers Register, and such economic matters as employment conditions, labor legislation, and social security legislation.

EJC has also been concerned with a code of practice of engineering, surveys of the profession, and relations with the United States Government to assist in the formulation of policies respecting national affairs wherein the engineers can be helpful.

The National Society of Professional Engineers has been concerned with registration, education and development of young engineers, employment practices, salaries and fees, the position of engineers in industry, ethics, and engineering practice. It maintains committees on national affairs, national defense, and legislation. There is some overlap.

There has been strong feeling in certain quarters that such overlapping was very undesirable, that it made for duplication of effort, confusion, and conflict.

The American Insitute of Electrical Engineers took part in the work of the Explora-

→ to next page

A certain engineer mounted a camel for an inspection trip around the Pyramids and the Sphinx. When he returned, he dismounted, stepped back a few paces, and gazed at the animal.

A friend who was nearby approached him and said, "Is something wrong with the camel?"

Said Joe, "Look at that beast, the drooping neck, the silly looking face with the drooling mouth, the two big humps on the back, that mangy-looking coat, the long legs with bony knees and great flat feet.

"Then look at that silly little tail with the brush on the end. Now, there is an animal that was put together by a committee!"

The camel resembles somewhat the organization of the engineering profession, except that that was not put together by a committee; on the contrary, like Topsy, it just "growed."

Unity of the engineering profession from preceding page

tory Group. While recognizing weaknesses in the plan brought forth by that body, it "went along" for harmony.

The AIEE Board of Directors has continued to give much attention to the matter of organization of the profession and has watched developments closely since the report of the Exploratory Group was implemented. At a meeting in San Francisco in 1956, the AIEE Board proposed a clarification of the division of activities and responsibilities among EJC, ECPD, and NSPE.

AIEE's Proposal

Specifically this proposal contemplates that EJC divest itself of activities in the fields of legislation, economic factors, and codes of practice. It would function primarily to coordinate technical matters crossing the boundaries of the various disciplines, and would retain its concern with recognition of specialties, honors for engineers, the National Engineers Register, and relations with corresponding bodies in foreign countries.

In the proposal, ECPD would continue to be charged with responsibility for the education and development of young engineers, the establishment of standards for engineering education, the accrediting of engineering curricula, and the canons of ethics.

It is proposed that NSPE relinquish its interests in the education and development of young engineers. It would continue its activities in relation to registration of engineers, economic factors affecting the employment of engineers, including salaries and fees, and would be solely responsible for formulating rules of behavior in accordance with the ECPD canons of ethics and for discipline under those rules.

NSPE would continue its interest in national affairs and national defense and would be the sole spokesman for the profession in matters of legislation affecting engineers.

It would be responsible for public relations to enhance the prestige and standing of the engineering profession as a whole. This does not mean that the technical societies would be prohibited from public relations activities in their own specific fields. The activities allocated to NSPE are those in the "professional group."

With regard to surveys of the engineering profession, the proposal contemplates that when the subject matter is technical in nature, EJC would function; when the subject is political or has to do with economic welfare and working conditions of engineers, NSPE would function.

Because of the special conditions affecting engineers in the various disciplines, it was contemplated that the technical societies would continue to take an interest in all matters affecting their members.

They would have appropiate commitees on such matters as education, registration, professional conduct, etc., for liaison with EJC, ECPD, or NSPE, as the case might be, to insure that those groups were kept informed and alert to the particular viewpoints of the members of the various societies.

Thus, the San Francisco policy was not a proposal that the technical societies should give up any of their present activities, interests, or services. It was, rather, a plan for clarifying the division among EJC, ECPD, and NSPE of those responsibilities which these organizations have been handling for the entire profession.

Obviously, the success of this plan and the strength of the organized profession will be greater if more engineers are members not only of a technical society but also of NSPE.

For this reason, AIEE proposes that NSPE open its membership for a period of years to unregistered engineers holding suitable grades of membership in technical societies subscribing to ECPD uniform membership grade standards. If NSPE will do this, AIEE undertakes to recommend that **all** its members join NSPE.

If, eventually, it is desired to amalgamate all the various societies into one unity organization for engineers, AIEE believes that the adoption of the San Francisco proposal will facilitate this end.

AIEE is not at this time taking a stand for or against such eventual amalgamation. It is recognized that there are certain practical difficulties in the way at the present time. However, even without such eventual amalgamation, AIEE believes that the San Francisco proposal would be a big step forward in the organization of the profession.

Worthy Goal

If we could have the clear-cut nonconflicting functional organization envisioned in San Francisco, and if all, or at least, a vast majority of the members of the technical societies were affiliated with NSPE, we would have an organization of the profession which would indeed be strong.

Certain other engineering societies have been favorably impressed by the San Francisco proposal and have taken steps to call it to the attention of their members.

It is to be hoped that the other societies will take parallel action and that the proposal may receive the positive endorsement of the other technical societies. ◆

A Dissenting View . . .

Points from an address on taking office by L. R. Howson, President, ASCE

. . . The Engineers Joint Council is a going federation of American engineering societies. It now embraces some fifteen societies with a combined membership of nearly 300,000 engineers. If it continues to serve the needs of engineering unity, it should include more than 600,000 engineers in the next twenty years.

As is always the case in the early life of federations, whether of political bodies or of engineering societies, there are divergent views as to the purpose, aims, and accomplishments of EJC.

Time will either erase these differences or demonstrate so clearly the advantages of unity in the profession that what differences may remain will assume lesser importance.

I believe that EJC offers the best opportunity for unity in the engineering profession that has been presented in the past one hundred years.

Undoubtedly future changes in it will increase its service to the profession, but I believe that the best interests of the profession will be served, now, if we give EJC an adequate, honest opportunity to demonstrate its value to the profession. . .

EJC and ECPD are federations of substantially the same engineering societies. NSPE is not a member of either of these federations, although it has made application for admission to ECPD. It is believed that the proposal (by AIEE in San Francisco) to segregate areas of responsibility would result in less unity in the profession rather than more, at least at the present time.

EJC has a professional practice department whose activities under this plan would be transferred to a society not even a member of the EJC federation of societies. It would appear that NSPE, whose membership is only some 15% of that of the EJC societies, could function best as a constituent member of EJC.

It is **unity** we are after. Let us concentrate on that single objective first, just as the American Colonies did. Having made a fine start through EJC, let us complete the job. Then through evolutionary rather than revolutionary processes let us develop and perfect this unity in the American way over the years, making changes as needed from time to time to conform to present and future needs.

Trouble-shooting an unusual water problem

Two cooling towers in similar service developed opposing pH trend . . . detective work showed why

By **DR. SIDNEY SUSSMAN,** Chief Chemist, Water Service Laboratories, Inc.

Most unusual water treating problem is reported from Lancaster, Pa. at the modern, fully air-conditioned Schick, Incorporated plant.

Air-conditioning equipment, a 150-ton compressor type cooling system and a 510-ton Carrier absorption refrigeration unit, went into operation in June 1955 and June 1956 respectively. Smaller unit cools 30,000 sq ft of office and cafeteria area, and the 510-ton unit cools 110,000 sq ft of manufacturing area. Each unit has a separate cooling tower.

Three weeks after the 510-ton unit went into operation, serious operating difficulties developed, which virtually shut down the air-conditioning equipment. After a careful examination of the system, Water Service Laboratories, Inc. was called in to survey the cooling water problem.

Samples of makeup water from each of the two cooling towers on the plant roof were sent to Water Service Laboratories, Inc. for analysis.

The Lancaster water being used in the plant's cooling system was hard and, as might be expected, the office cooling tower was developing very strong scale-forming conditions. Surprisingly enough, however, analysis of water taken from the plant cooling tower, located only 150 feet from the office tower, revealed very strong corrosive conditions. Deposits collected from the condenser attached to the plant tower contained iron and copper compounds formed by the corrosive attack of the circulating water on metal parts of the system. An iron thermocouple well removed from this system showed a heavy copper plate, formed from copper that had been dissolved from the refrigerant condenser tubes. Deposits taken from the pan of this cooling tower revealed the presence of much air-borne organic matter.

Studying the analysis results, Water Service Laboratories' chemists, without actually visiting the plant, were able to deduce not only the cause of this most unusual problem, but also locations of the various pieces of equipment involved in the solution. Their report declared that the larger cooling tower was located close to, and downwind from a smoke stack, and that the discharge from the stack entering the tower was causing the water to become extremely corrosive. The smaller office cooling tower, not being affected by the stack, was subject to the formation of scale — as might be expected from the city water composition.

These deductions were confirmed by Schick, and steps were immediately taken to remedy the situation. Height of the smoke stack was increased by about 15 feet so that it discharges above the nearby tower. This has eliminated the primary cause for the corrosion-producing condition and for the large amount of air-borne dirt left in the pan. Secondly, based on the analysis of deposits found, the condensers received a thorough chemical cleaning. Finally, regular water treatment service was started by Water Service Laboratories' Philadelphia branch. This was done by connecting a Chemistat or proportioning feed to the circulating water system. This assures the introduction of chemical solution in continuous small amounts whenever water is being circulated. To maintain the desired concentration of chemicals at all times, chemical solutions must be fed continuously in a small stream rather than by intermittent dosing. After treatment was begun, water samples were collected at regular intervals for analysis to maintain proper control.

After these corrective measures were taken, the air-conditioning equipment operated normally and without incident for the remainder of the season. When the cooling equipment was opened for inspection at the conclusion of the season, it was found to be in excellent condition.

(Trouble-shooting was done by Water Service Laboratories, Inc., 423 W. 126th St., New York, N.Y.)

Circle 1416 opposite last page.

Proximity of this stack to the plant cooling tower resulted in a strong corrosive condition which disrupted air conditioning at the new Schick, Inc., plant at Lancaster, Pa. Water Service Laboratories, Inc., suggested increasing stack height by about 15 feet and installing a cooling water treatment unit at the tower.

Financing the future for utilities

By **CHARLES E. OAKES,** President
Pennsylvania Power & Light Company

THERE IS NOTHING more difficult, nothing more perplexing in the realm of business management, than financing plant expansion, especially where it extends well into the future. Particularly now does the future seem obscured with an unsettled world. At home, we predict a doubling of our load in ten years and also, we have twin threats of further inflation and unwarranted government invasion. Further, the whole new energy concept opened up by the atom, requires vast sums to achieve practical usefulness. Nevertheless, our most certain guide to the future is the judgment we have gained by past experience, perhaps not in detail but in principle.

At the end of 1917, there were 4224 corporate electric systems in operation. Loads were growing, and with advances in the art of transmitting power, there began the gradual interconnection of groups of towns, each drawing from a common pool. These changes reduced the number of operating systems to 2135 by 1927.

Coming down to more recent experience, the post World War II years have demonstrated dramatically the growth potential that characterizes our industry. Since the end of the war, investor-owned utilities have added over 50-million kw of generating capacity — more than a 120% increase. Customers exceed 42½ million — a gain of better than 50%. Together with an accompanying increase in the use of power in home and industry, construction expenditures rose rapidly from an annual level of $2/3 billion in 1946 to almost $3 billion in 1956. Altogether construction expenditures have totaled $24 billion in the past 11 years.

Financing in Billions

Financing this unprecedented growth has been achieved successfully and in a highly satisfactory manner. What were the sources of cash during this 11-year period to finance this $24-billion expansion program? About $9 billion (38%) came from operation of the business — depreciation, retained earnings, and other internal sources. The rest, $15 billion (62%), was realized from the sale of securities. Long-term debt accounted for $9.8 billion; preferred stock, $2.1 billion; and common stock, $3.1 billion.

Large amounts of these securities, particularly the equity portions, have been purchased by local individuals. More and more we are becoming a customer-home-owned industry. Home ownership of equity securities should be developed. It can be an important factor in raising the future funds we will need and its public relations' value is very great.

Shortly after the war, insurance companies entered the market as substantial buyers of preferred stocks sold by electric companies in an endeavor to secure higher yields for policyholders. Life insurance companies have also taken huge amounts of bonds. At the beginning of 1956, they held $7.7 billion in their portfolios — more than half the long-term debt of the electric utilities.

Taking the latest figures available (1955), plant account of the investor-owned electric, companies was $34.0 billion. As against this, there were outstanding securities aggregating $25.8 billion, consisting of $14.5 billion of long-term debt, $3.5 billion of preferred, and $7.8 billion of common stock. In addition, the combined surplus account of $2.7 billion gave a total capitalization of $28.5 billion. Thus, in terms of total capitalization, long-term debt represented 50.7%, preferred stock 12.3%, and common stock and surplus 37.0%. Comparing these ratios with 1945, we find that long-term debt stood at 46.5%, preferred at 15.7%, and common stock and surplus at 37.8%. So you can see that we have maintained the soundness of our financial structure in creditable fashion.

And that brings us to the question of the future.

First, as to the physical situation. We have passed through the difficult period of catching up with war-time-postponed construction. As our loads continued to mount, other substantial property additions became necessary and were made. The result has been that most companies find themselves with a high percentage of property that is relatively young. As an example, studies we made show a decrease in the average age of Pennsylvania Power & Light Company property from 19.3 years at the end of 1947 to 16.7 years at the end of 1956.

Where We Stand Now

So we now are at the point where the construction immediately ahead will be more closely related to meeting customers' needs. This, it seems to me, is highly significant. We should find from here on that new property construction will be pursued more directly and be more quickly

CHARLES ERNEST OAKES, President of Pennsylvania Power & Light Co., was born 1892 in Pendleton, Ore. He was educated at Oregon State College, BS 1915, and at Cornell University, MME 1917. Mr. Oakes began his career as an electrical engineer with the National Bureau of Standards, Washington, D.C. in 1917. He became electrical engineer for the Federal Power Commission in 1921, and joined Pennsylvania Power & Light Co. in 1923. In 1945, he was elected President and Director. Mr. Oakes is also a member of the board of directors of the Edison Electric Institute, a member of the executive committee of the association of Edison Illuminating Companies, and director and executive committee member of the National Association of Electric Companies.

productive of income-producing revenues. Thus, these expenditures will find more ready reflection in earnings, an important factor in attracting necessary capital.

I had a study made concerning the growth of our industry and projected it to 1970. The findings bear directly on this problem of financing the future. Our forecast shows a population of 200 million, a potential labor force of 84 million, and a gross national product, in terms of 1953 dollars, of $600 billion. With the productive labor force then available, it would be impossible to achieve a $600-billion gross national product without raising the productivity per man-hour. Further study shows a close relationship between man-hours, electric power, and gross national product. From this, it is evident that more than 7 kwh/man-hour will be required as compared to a little over 3 at present. This means, therefore, that by the middle 70's, if we are to reach a $600-billion economy, business and industry will need over 830-billion kwh. Coupled with the expanded needs of the 57-million residential and rural consumers in 1970 and miscellaneous other sales, and including losses, we find that 1-trillion, 400-billion kwh will be needed. This means a total generating capacity of some 310-million kw by private and government sources, or nearly 200 million more than we had last year.

Of this 310-million kw needed for 1970, the investor-owned portion will be around 250-million kw. Taking this into account along with related facilities and properties, it is estimated that the electric companies are facing new construction of about $70 billion, that we might expect $25 billion of this to be available from depreciation and retained earnings, and that the balance ($45 billion) will have to be new money. Moreover, it seems reasonably certain that the industry should be able to generate this $25 billion from internal sources. This could be done while essentially maintaining our present capitalization ratios and increasing the common dividend payout to around 80%.

Never-Ending Job

Certainly, raising $45 billion of new money is a rather startling prospect. But it is in line with what seems slated to take place in this country of ours. It presents no new task, but the same never-ending job we have, as a major-growth industry, of continually seeking expansion funds.

Among other things, it emphasizes clearly the urgent need to continue the healthy appearance that we now have on our balance sheets and income statements. We must keep in mind that we have no preferred position with respect to the investing public. We will not be alone in seeking the investors' dollars. Industrial enterprise in every field will be claiming its share of capital as it struggles to supply the needs of a growing population. We may be sure, too, that government—Federal, State and local—will continue to impose its heavy demand on the money supply. So, if we are successfully to solve our fiscal problem, we must preserve a high degree of financial integrity.

We must realize that the investor looks critically at our capital structure. I think that we should strive to hold to a capitalization ratio of 50% debt and 50% equity, with the common equity portion ranging from 30 to 40%.

It is obvious that earnings must be kept at levels attractive to the equity investment market. The trend in earnings and the ability to secure equity money provide the base upon which successful senior financing rests. Holding to a satisfactory earnings position, in an atmosphere of the creeping-type inflation we have been experiencing, is not easy. The beneficial effect of post-war replacement of less efficient equipment and other non-recurring changes have enabled us to offset to a great extent the effects of higher wages, equipment, and material costs. Now, most of this is behind us, and from here on we will have to meet rising costs by courageously seeking rate increases to secure sufficient earnings to attract capital.

Money costs are signaling that another point in world-wide inflation has been reached—and as long as we hold to the present high point of economic activity, we may expect money to be tight.

Fiscal Know-how

While some might say the present picture of high money costs is not encouraging, it does not seem to me to be unnecessarily drastic. This calls for a high degree of fiscal know-how—careful timing, proper selection of financing to get the lowest money costs, and thorough knowledge of the money market.

This must be coupled with the ability to anticipate well ahead of needs. A mistake in timing, selection of securities

→ to page 46

World's first completely air-conditioned men's clothing plant uses . . .

Package Units

A Power Industry Photo Report

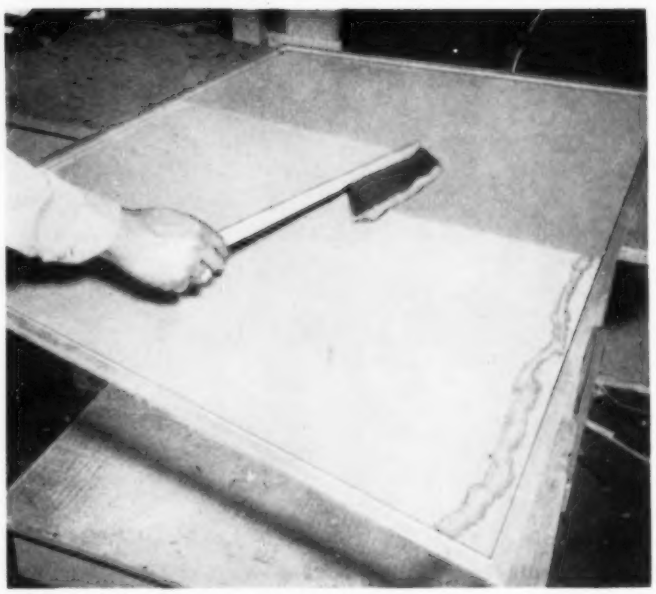
By **DONALD HARTLEY,** Managing Editor

A half-million dollars worth, some 1100 tons, of package air conditioners are providing temperature and humidity control at H. Daroff & Sons, Inc., Philadelphia clothing plant. "Botany 500" and "Worsted-tex" clothing is made in this first completely air-conditioned men's clothing plant in the world.

Before the system was installed, thousands of man hours and production of thousands of garments were lost each summer. The plant bottle-necked in its efforts to produce and deliver on time.

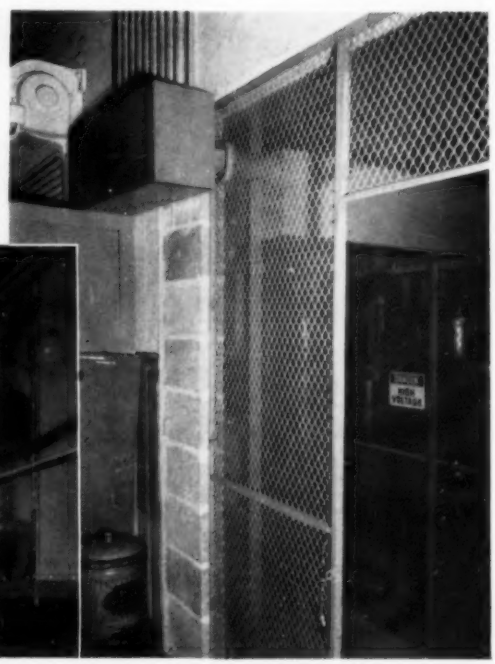
The industry has had two problems for generations — maintaining controlled humidity, vital to good tailoring, and attracting skilled labor. This is the first plant to lick both problems simultaneously. Biggest engineering headaches were shortage of floor space and large amount of airborne lint in plant atmosphere.

(Package air conditioners were furnished by General Electric Co., 1 River Road, Schenectady, N. Y.)
Circle 1417 opposite last page.

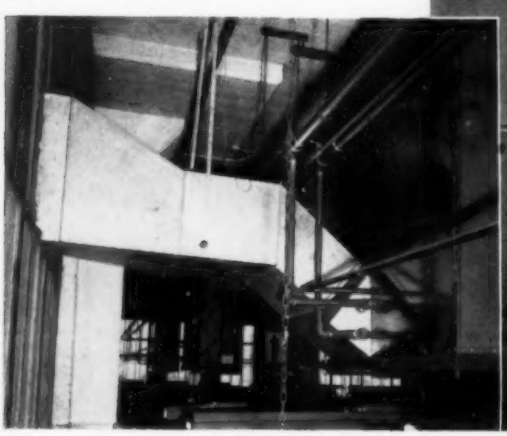


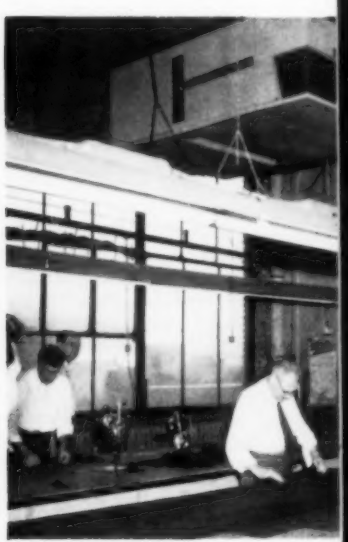
Domestic flyscreens, mounted in air intakes of units recirculating air, trap lint from plant atmosphere. After 10 hours operation, a 4-in. ball of lint is collected from each.

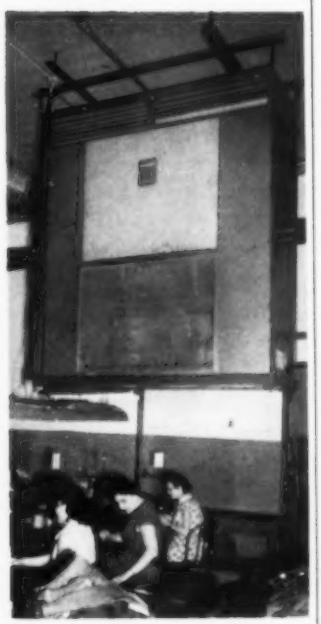
Units each have a 15-hp motor, so electric distribution was a major problem in plant already short of floor space. Solution was found in pouring floors in old elevator shaft, and housing transformers there. Floors not used for transformers have made good storage areas.



Four 15-ton units on each of five manufacturing floors bring in outside air to maintain positive pressure. Copper pipe is used throughout cooling system.

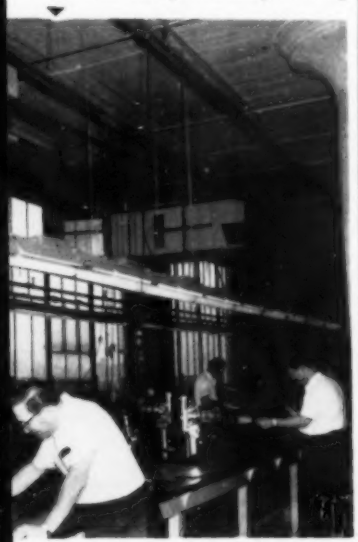






Floor space was at a premium, so 1600-lb units were suspended from supports that pass through 10-in. reinforced concrete floors above. Each unit has its own thermostat, mounted on wall or adjacent post.

Cutting room has air-cooled 5-ton units suspended from ceiling, all bringing in outside air. Most units are located around outside walls of block-long plant, but pressing room has unit right above steam presses. Too little moisture causes static problem, and too much destroys all benefits of final pressing operations, essential for good-looking clothing.



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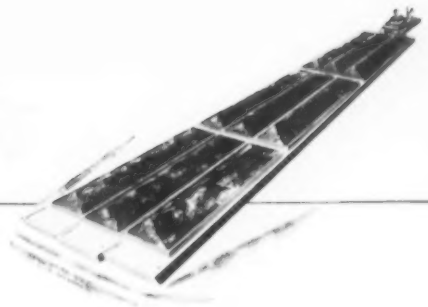

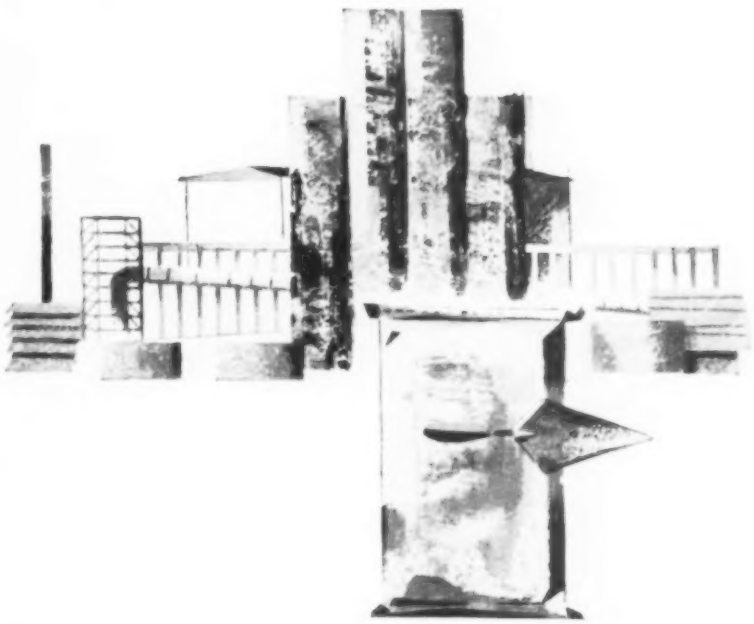

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Circle 1418 opposite last page.

2500 students at work in Massapequa High School on Long Island made it imperative that heat economy should not involve a noisy boiler room. Planning and good design achieved . . .

ECONOMY IN A WHISPER

By **EDGAR A. BURT**
Chief Engineer
Massapequa High School

Steam and hot-water needs for Massapequa High School, Long Island, N. Y. are provided by three package automatic boilers. The high school serves 2500 students and serves as an excellent illustration of how extreme boiler room quiet and economical operation can be obtained.

The excellent operating economics coupled with the architecturally attractive exterior are the result of wholehearted cooperation between the planning committee, the architect, and the engineering constructors.

Package automatic boilers suited to burn No. 6 fuel oil were selected. For more than two years, the three boilers have been burning this, gaining important fuel savings.

Steam and hot water for the 177,800 square feet of floor area in the school building are provided by three package automatic boilers specified as the equipment best suited to burn inexpensive No. 6 fuel oil. For more than two years the boilers have been paring plant operation costs daily.

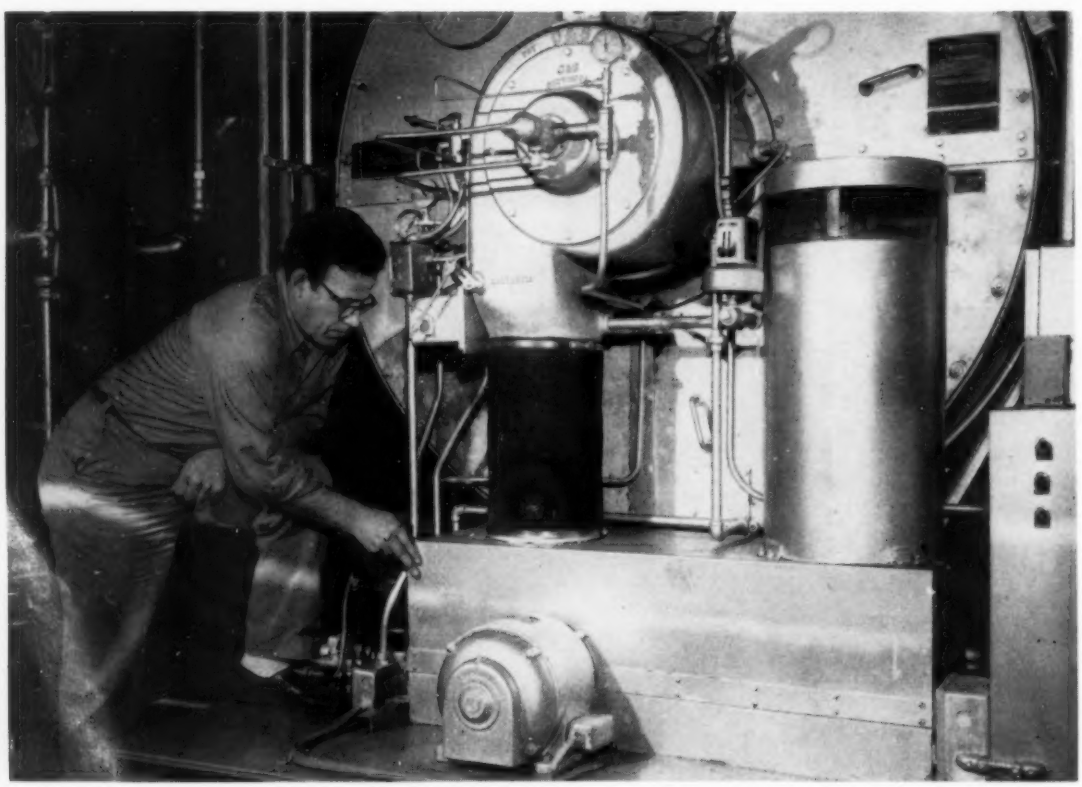
No. 6 fuel oil costs about 6c/gal on Long Island, compared with 9c/gal or more for lighter fuels. It is thick, gummy, difficult to burn, and often costly to use because equipment may have to be cleaned frequently if combustion is not perfect.

In addition, imperfect combustion may cause a smoke nuisance, which no power plant, in today's air-pollution-conscious age, can afford to create. Poor combustion also entails fuel being wasted.

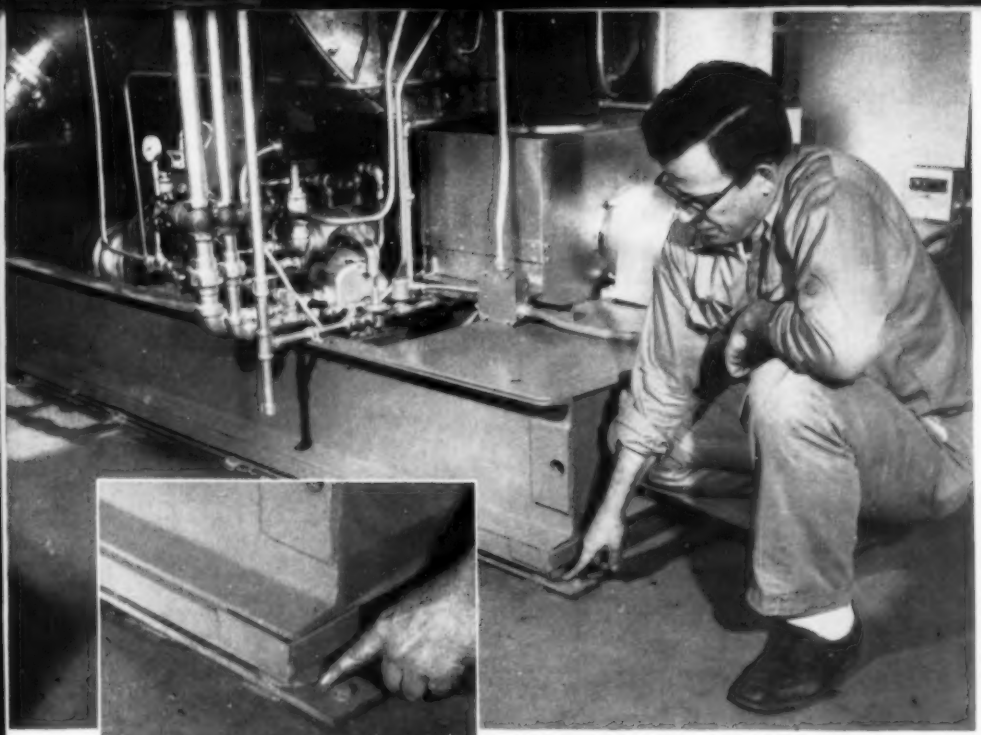
For these reasons, No. 6 fuel oil is rarely used in Long Island schools. School authorities would rather use a lighter, more expensive fuel to escape the problems involved in burning residual fuel oil.

At Massapequa High School, however, the citizens' committee wanted to study every possible area of cost reduction. They welcomed the latest technical information on boilers from manufacturers. They studied the question of fuel oil grades. In grading various boiler equipment, the following factors were considered:

- Ability to operate on No. 6 oil on year round basis with minimum maintenance and trouble
- Minimum carbonization of burner tip
- Relative cleanliness over long periods
- Response to fluctuating steam demands
- Close synchronization of fuel and air over wide ranges.



Three of these package automatic forced-draft boilers supply maximum heat needs of the 177,800 square foot school building.



Rubber damping strips under channels absorb vibrations which might be transmitted through the floor.

Closeup shows details of mounting which absorb vibration.

Reports indicated that, providing the proper boiler equipment were used, No. 6 fuel oil could be burned with freedom from operational difficulties. Thorough study resulted in the selection of three 150-hp package boilers for school's needs.

Boilers are fully automatic, operating at 83-85% efficiency through full operating range. They respond immediately to fluctuations in load requirements from 20 to 100% of full load during a single school day. Both air and fuel supply are controlled to provide the exact mixture needed for efficient combustion.

Automatic firing guarantees getting maximum heat from every drop of oil. And fast regulation of heating equipment, to meet constantly changing needs of the building, also cuts fuel costs.

Reduction in fuel costs through efficient utilization of No. 6 oil makes possible a saving of $500 per year over the lighter fuel for each of the three boilers that operate full load during a 10-hour day.

Boilers used in Massapequa High School are three-pass horizontal boilers with forced-draft air supply. Combination steam and electric fuel preheater raises oil to 200°F. Preheated fuel is fired into a central tube, with hot gases returning through tubular passages directly beneath the boiler. Gases then flow through the third-pass flues on either side of the combustion tube to the rear vent, for exhaust.

Advantage of forced draft is that combustion is freed from atmospheric vagaries. Burning can be completely controlled — regardless of ambient pressure.

On the other hand, a variation in wind speed or direction can affect natural draft to the point where smoke, poor combustion, and general boiler troubles may result. It is a well-known fact that wide variations in natural draft are a major cause of low efficiency and high boiler maintenance in schools where forced draft is not utilized.

A relatively inexpensive vent, properly insulated against vibration, is used in place of tall stacks required by natural draft furnaces. Eliminating the stack not only saves money on original installation, but actually adds to the architectural beauty of the building.

A potential equipment noise problem confronts architects and engineers who plan every school today. Through use of boiler room equipment designed to operate with extreme quiet, and through an ingenious system of soundproofing, no noise problem exists at Massapequa High School.

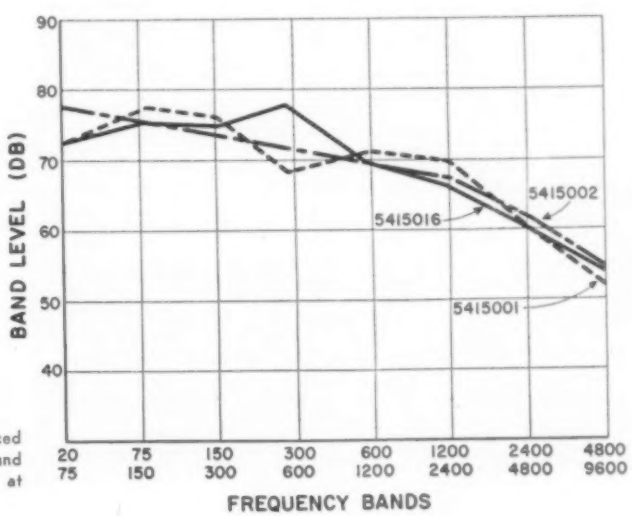
Noise abatement problems were complicated by the fact that all boiler room equipment, blowers, compressors, and motors were located adjacent to school rooms. Equipment level was only slightly lower than the central portion of the school structure. Deeper excavation was ruled out by the relatively high ground water typical along the Long Island shore.

Extra precautions were required because boiler room windows face on an open court yard, which could serve as a sounding board for any noises generated by the heating and air-handling equipment. The court yard is surrounded on three sides by classroom areas.

Most boiler room noises fall into the four lowest octave bands ranging from 20 through 600 cps. These are the hardest noises to eliminate or minimize. Walls, draperies, and other building and equipment components absorb higher sound frequencies much more readily than the very low sound frequencies.

Also of importance is the fact that boiler room noises are often transmitted as vibration along piping, air ducts, or building members to school

→ *to page 33*



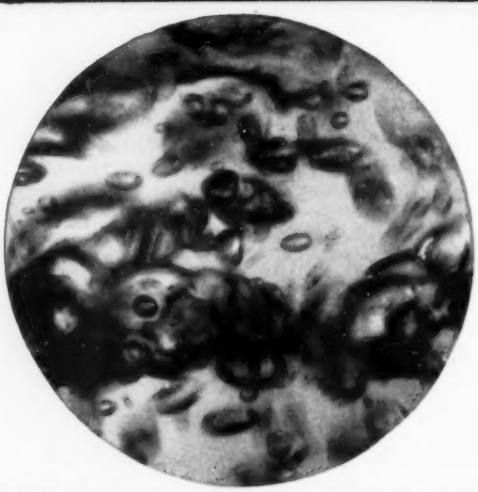
Sound spectrum of the noise produced by boilers shows that most of the sound is low frequency. Sound level tests at the school were satisfactory.

BEFORE CONCENTROL—Foaming of highly alkaline solution in glass test cylinder.

HERE'S PROOF:

CONCENTROL

CONTROLS FOAM AND BOILER WATER CARRY-OVER



AFTER CONCENTROL—Same solution after addition of 12 ppm of Concentrol Antifoam.

Where boiler water carry-over is caused by foaming due to high alkalinity and high proportion of dissolved solids in the water, Concentrol provides a low cost, effective method of chemical treatment and control. Supplied in liquid, powder or briquet form—to be fed continuously or in slugs to boilers—Concentrol is essentially a surface agent that causes breakdown of bubble film to prevent foam formation. Formulations of Concentrol can include organic sludge conditioning agents and other water treatment chemicals for boiler treatment as well as antifoam. Fast acting and resistant to hydrolysis or breakdown under normal boiler temperatures and pressures. Eliminates need for costly pre-treatment of water and high blow-down rate.

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Circle 1419 opposite last page.

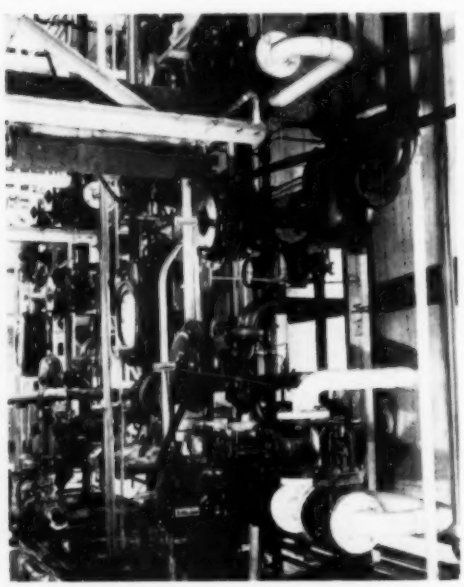
Light-wall stainless pipe keeps makeup water pure

Highly acid river water requires considerable treatment before being used as boiler makeup water for Pennsylvania Electric's Shawville station. Makeup to the system averages 50 gpm (¾% of boiler steam flow). With pH values of influent water running as low as 3.2, the first step is to raise the pH to the range of 6.3 to 7.2.

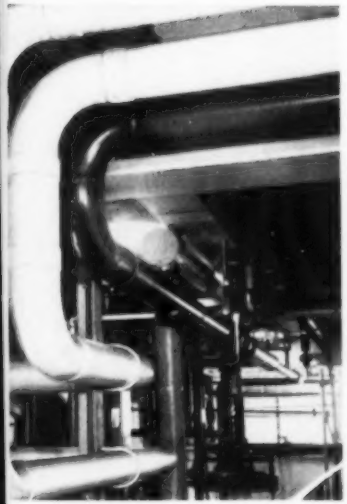
After initial neutralization to raise pH, influent water passes through demineralizers to reduce total solids content to less than 1 ppm.

To maintain high-purity water for boiler makeup, water system piping consists entirely of light-wall stainless steel pipe. Several alternatives were under consideration including rubber-lined pipe, but the initial cost plus installation savings made the stainless pipe more economical.

After considerable thought, Shawville engineers selected type 316 stainless steel pipe. Cost of stainless compared favorably with ordinary black steel piping. Speedline stainless fittings presented no problems in fitting up to equipment and other pipe.



Schedule 5 stainless steel pipes used for feedwater piping. Flanged fittings are installed where frequent changes are needed.



Shawville engineers find that stainless pipe reduces installation costs by saving both materials and time, and insures water purity.

Initial cost of light-wall pipe is lower than conventional schedule 40 steel pipe because substantially less material need be purchased. With schedule 40 black steel pipe, fittings are normally threaded. Such threading reduces pipe wall thickness and increases leak frequency.

Permanent pipe connections are welded. Speedline fittings permit welding all standard sections. This can be done directly or by using an aligning connector that simplifies the job and prevents possible formation of icicles inside the pipe weld.

A full range of elbows, tees, reducers, and so forth, are available.

Insert Flanges

Joints that may be disconnected later for one reason or another may be joined by expanding either the pipe or fitting directly into the Speedline insert flange. Insert flanges are then bolted together and later may be easily disconnected.

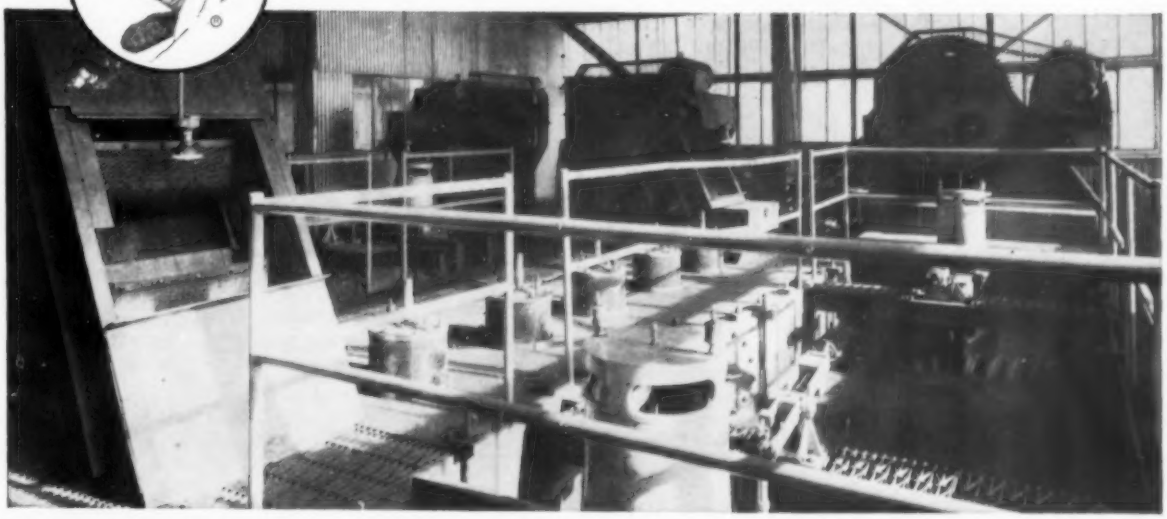
Shawville also installed schedule 10 stainless steel and Speedline fittings for its dilute acid lines.

Again, there has been no maintenance problem and no leakage.

(Speedline stainless fittings were furnished by Speedline Div., Horace T. Potts Co., Erie Ave. & D St., Philadelphia 34, Pa.)

Circle 1420 opposite last page.

WHY CHESSIE'S RAILWAY IS FIRST IN COAL



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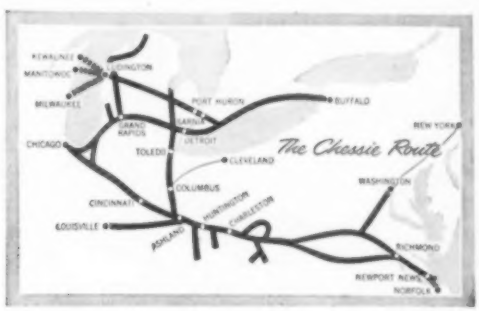

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POWER BASICS FOR TODAY'S INDUSTRY

Fluid mechanics—VI

PIPELINE PROBLEMS

J. M. ROBERTSON
Professor of Theoretical & Applied Mechanics
University of Illinois

How to predict requirements of pipelines? This section deals with the common variables which must be considered when pipelines are designed, modified, or examined. By using the techniques explained here you can find estimated pressure drops, flow rates, pipe size required. This information is worth your time — read it now or save it for future reference.

When discussing turbulent flow in pipes, we noted how to determine head loss due to pipe friction or fittings. Our problems are not always straightforward. They are complicated by the interactions between the various parts of a piping system. Our purpose here is to review some of the principal fluid mechanics techniques that aid in solving such problems.

We have seen that it is easy to determine head loss due to pipe friction if we know rate of flow, pipe size, and nature of fluid and pipe. We merely calculate the flow Reynolds number

$$R = \frac{VD}{\nu} = \frac{4}{\pi}\frac{Q}{D\nu}$$

and relative roughness

$$\frac{\epsilon}{D}$$

and look up the value of friction factor f that corresponds with these on a suitable graph. Head loss is then calculated from the equation

$$h_f = f\frac{L}{D}\frac{V^2}{2g} \qquad (1)$$

Since all factors on the right side of the equation are known or can be found, the solution is direct. But not all of our problems occur in this fashion. We may wish to find what size pipe is needed to carry a given flow rate a certain distance with a certain head loss. Or we may wish to determine what rate of flow would occur through a given pipe line under a given head loss.

In the first instance, diameter D is unknown. In the second, rate of flow Q is unknown. In neither case can we find the Reynolds number that is needed to determine friction factor. Without this we cannot solve eq. 1 for the diameter or discharge.

The usual method of solving such indirect problems is the trial-and-error approach (the method of successive approximations). The solution may be initiated by assuming a value for either the friction factor or velocity — it does not matter which.

If velocity is assumed, it is used to calculate Reynolds number, which permits estimation of friction factor. Once a value for f is available, we solve eq. 1 for the unknown diameter or velocity. For this purpose, we express eq. 1 as

$$f = \frac{h_f D^5}{LQ^2}\frac{g\pi^2}{8} \qquad (1a)$$

With f known, this equation may be solved for D in the first of our problem types, or for Q in the second. In either case, all other factors in eq. 1a are known. In this manner we obtain the first approximation to the unknown quantity. Since

$$Q = \frac{V\pi D^2}{4}$$

we can calculate velocity for this approximation.

We are now ready for our second round of calculations, starting with the velocity obtained from the first approximation. Only a few recalculations are needed, since the result converges rapidly to the correct value of velocity.

In spite of the simplicity of this procedure, a direct approach is better if we have many such calculations to make.

For the direct solution, two other dimensionless similarity parameters are in terms of the known quantities that affect the flow. These have no specific names, like Reynolds number, so we term them the **S** and **T** parameters. The first of these, similar to a parameter used by Reynolds, does not involve rate of flow Q and is

$$S = \left\{\frac{gh_f D^5}{L\nu^2}\right\}^{\frac{1}{2}}$$

and, for the case where diameter is unknown, the second is

$$T = \left\{\frac{gh_f Q^3}{L\nu^5}\right\}^{\frac{1}{3}}$$

For any specified relative pipe roughness, it is as easy to present the friction factor as a function of **S** and **T** as it is of **R**. The transformation is simply made since

$$S = R\left\{\frac{f}{2}\right\}^{\frac{1}{2}}$$

and

$$T = R\left\{\frac{f}{4}\right\}^{\frac{1}{3}}$$

The three curves of f versus **R**, **S**, and **T** for smooth pipes are shown in fig. 1. We could plot the whole family of relative roughness curves as functions of the two new parameters, just as we usually do for **R**. Alternatively, coordinates for these new parameters could be superimposed on our conventional plot of f as a function of **R** and

$$\frac{\epsilon}{D}$$

Laminar vs. Turbulent

Plots such as those in fig. 1 become unnecessary below the transition region (shown dotted in fig. 1) between turbulent and laminar flow. When laminar-viscous flow occurs, the Hagen-Poiseuille law may be solved directly for the unknown Q or D.

In the case of turbulent flow calculations for the unknown diameter in rough pipe, difficulties arise in connection with the relative roughness. For plotting rela-

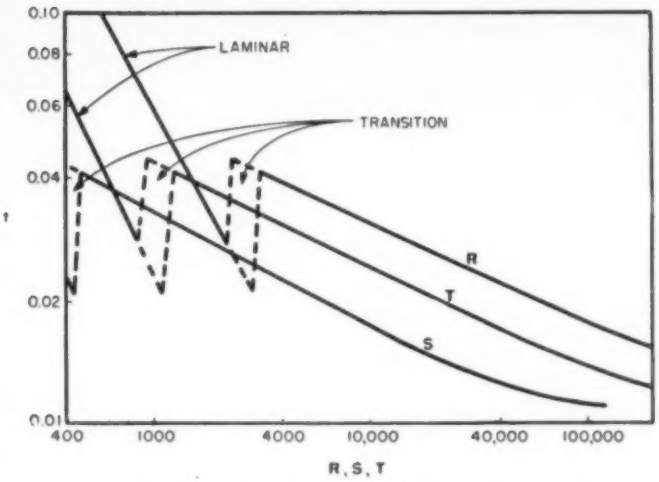

fig. 1 Friction factor (f) varies with the Reynolds number. It shows similar variations with the parameters S and T.

tive roughness lines on the **T** plot in a form not involving diameter D, we must use a new roughness parameter obtained by multiplying

$$\frac{\epsilon}{D} \text{ by } \sqrt[5]{f}.$$

Inspecting the relationship for f given by eq. 1a will indicate that

$$\left[\frac{\epsilon}{D}\right] f^{\frac{1}{5}}$$

is a new dimensionless roughness parameter not containing the diameter.

For presenting friction data as a function of our other parameter **S**, it is satisfactory to continue using

$$\frac{\epsilon}{D}$$

because the diameter is known in this situation.

EXAMPLE: What size of smooth pipe is required to convey 0.25 cfs of liquid sodium at 660°F distance of 50 feet, with 10 psi of loss?

SOLUTION: At this temperature, kinematic viscosity of sodium is 4.5×10^{-4} ft²/sec, and specific weight is 56 lb/ft³, therefore

$$h_f = \frac{10 \times 144}{56} = 25.7 \text{ ft}$$

and

$$T^5 = \frac{g h_f Q^3}{L \nu^3} = \frac{32.2 \times 25.7 \times (0.25)^3}{50 \times (4.5 \times 10^{-4})^3}$$

$$= 1.4 \times 10^{15}$$

or $\mathbf{T} = 1690$ and from fig. 1, $f = 0.039$. We solve eq. 1a for the diameter

$$D^5 = \frac{f L Q^2}{h_f g} \frac{8}{\pi^2} = \frac{0.039 \times 50 \times (0.25)^2 \times 8}{25.7 \times 32.2 \times \pi^2}$$

$$= 0.000119$$

whence

$$D = 0.164 \text{ ft or } 1.97 \text{ in}$$

or say a 2-in. diameter pipe.

Since pipelines are often long and minor losses seem less important than pipe friction losses, the question naturally arises — when can we neglect them?

It is often stated that when a pipe is more than a thousand diameters long we may neglect the effect of minor losses. Unfortunately the criterion is not that simple. It depends upon the friction factor of the pipe and the loss coefficients of the various minor loss-causing items. The only sure way of evaluating the relative effect of minor loss items is through calculation of their effects in comparison with the major loss.

To indicate conditions under which various losses may be neglected, consider a pipe with a well rounded entrance ($K = 0.05$), a sharp or square cornered entrance ($K = 0.5$), or one with an open globe valve ($K = 10$). If the pipe is smooth or of a material such as galvanized iron, welded steel, etc. for which the roughness appears to have an essentially unique value, we can determine friction factor with a certainty of 2 to 5%.

In such a case the contribution of the minor loss is within this uncertainty (and hence negligible) for the rounded entrances if the pipe is 50 to 100 diameters long.

For the sharp entrance, the pipe must be 500 to 1000 diameters long and for the valve, 1200 to 2500 diameters long, before we can neglect these minor losses. Actually, we cannot ignore a valve in a line no matter how long the pipe is, because its loss coefficient increases rapidly as we close the valve.

In some pipelines, such as those of riveted steel or concrete, the surface roughness may vary by as large a factor as 10.

This may result in an uncertainty in the friction factor of 50 to 100%. In such an example, it is silly to consider minor losses except in extreme cases, such as with very short pipes or partly closed valves.

It is obvious that no simple criteria can be established to tell us when we may ignore minor losses. In case of doubt, it is best to play safe and estimate minor as well as frictional losses.

It is a big help to draw lines representing the hydraulic and energy grade lines on a sketch of the pipeline. The hydraulic grade line is a plot of the

$$\frac{p}{\gamma} + Z$$

terms of the Bernoulli relationship. Since Z indicates pipe elevation, the vertical distance between hydraulic grade line and pipe indicates the pressure variation along the pipe.

The energy grade line represents a plotting of the sum of the three Bernoulli terms

$$\frac{p}{\gamma} + Z + \frac{V^2}{2g}$$

and is obviously located one velocity head above the hydraulic grade line.

Hydraulic and energy grade lines not only aid in visualizing what is occurring, but they are particularly useful in analyzing complex pipeline problems.

It is not always necessary to determine their locations precisely to obtain an indication of important flow occurrences. Thus, in fig. 2a, the hydraulic grade line indicates that the pressure at point B is obviously below atmospheric. Although it may not be low enough to cause cavitation, it may lead to air leakage or accumulation in the pipeline. These result in partial air binding. Location of air release valves at this point would be worse than useless, since they would only admit more air.

Another problem which might arise at such a point is that the pipe would be sub-

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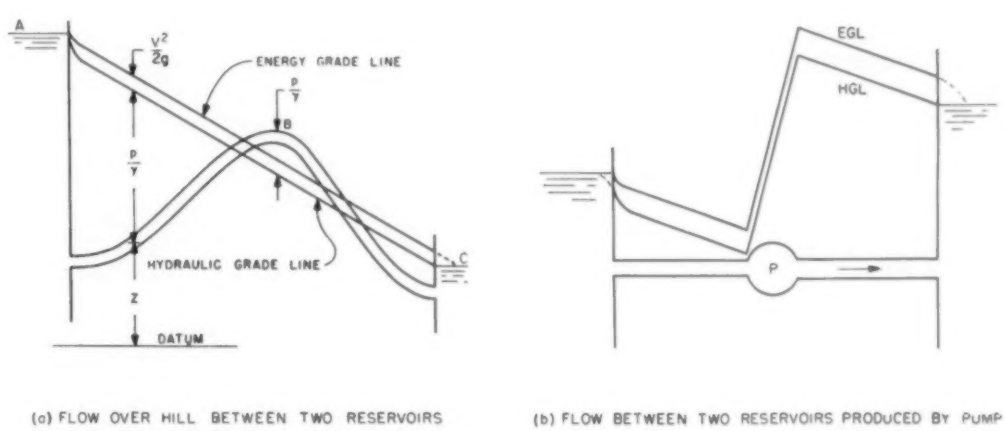

(a) FLOW OVER HILL BETWEEN TWO RESERVOIRS

(b) FLOW BETWEEN TWO RESERVOIRS PRODUCED BY PUMP

fig. 2 Hydraulic and energy grade lines help show what happens. Note that at point B (fig. 2a) that the pressure is less than atmospheric. Note also (fig. 2b) how a pump causes an upward jump in the energy grade line. Motors and turbines cause a corresponding drop.

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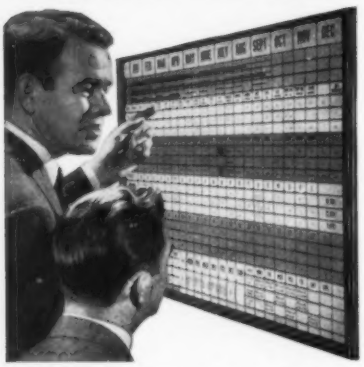

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ject to collapse if it had inadequate strength against external pressure. Sketches of the hydraulic grade line obviously indicate where these and other problems may arise.

Hydraulic and energy grade lines are simply constructed from calculations of head losses and velocity heads. For pipe of constant diameter, both lines slope uniformly downstream except at the locations of minor loss elements.

Therefore, we calculate the elevations of the lines at locations before and after each minor loss element or change in pipe size. The energy grade line always slopes downstream, indicating a continuing loss of energy or head, except where a pump is located.

A pump causes an upward jump in the energy grade line as shown in fig. 2b, since it increases the head or energy of the flow. Conversely, a turbine or motor causes a sudden drop in the energy grade line because it extracts energy from the flowing fluid.

Minor losses are shown as occurring essentially at the location of the element causing them, although the loss actually takes considerable diameters to develop fully.

The **hydraulic** grade line normally slopes in the downstream direction, but in a few instances it will rise even when there is a head loss. Thus, in a sudden expansion or diffuser there is a conversion of kinetic into pressure flow energy, even though there is a head loss, and the pressure will rise.

EXAMPLE: Determine the hydraulic and energy grade lines for the flow of water from a reservoir (elevation 100.0 ft) through 50 feet of 3-in. pipe, 100 feet of 5-in. pipe containing an open globe valve, and terminating in a 5- by 3-in. nozzle at an elevation of 85.0 feet. The pipe entrance is sharp edged, there is a sudden expansion from the 3- to 5-in. pipes and the valve is located half way along the 5-in. pipe. The pipeline is as sketched in fig. 3.

SOLUTION: We must first find the rate of flow through the pipeline. Tentative calculations indicate that $f = 0.02$ for both pipes and that we may neglect losses in the nozzle. Writing Bernoulli's theorem between the surface of the reservoir and the jet discharging from the nozzle, we have

$$\frac{p_1}{\gamma} + Z_1 + \frac{V_1^2}{2g} = \frac{p_2}{\gamma} + Z_2 + \frac{V_2^2}{2g} + h_L$$

$$0 + 100 + 0 = 0 + 85 + \frac{V_2^2}{2g} + h_L$$

Head loss h_L consists of an entrance loss (0.5 of the velocity head for a sharp edged entrance), pipe friction in the 3-in. pipe, sudden expansion loss, friction in the 5-in. pipe, and the valve loss. Velocity in the 3-in. pipe is equal to jet velocity (V_2), and the first two losses are expressed in terms of this velocity. For the last two losses, velocity head in the 5-in. pipe is involved. With the aid of continuity we relate this to V_2 by the relationship

$$\frac{V_5^2}{2g} = \frac{V_3^2}{2g}\left(\frac{3}{5}\right)^4 = 0.129\,\frac{V_2^2}{2g}$$

for the sudden expansion loss, we have

$$h_L = \frac{(V_3 - V_5)^2}{2g} = \frac{V_3^2}{2g}\left[1 - \left(\frac{3}{5}\right)^2\right]^2 = 0.41\,\frac{V_2^2}{2g}$$

Our relationship for the losses is therefore

$$h_L = \left[0.5 + 0.02\,\frac{50}{\frac{3}{12}} + 0.41 + (0.02\,\frac{100}{\frac{5}{12}} \times 0.129) + 10 \times 0.129\right]\frac{V_2^2}{2g}$$

$$= (0.5 + 4.0 + 0.41 + 0.62 + 1.29)\,\frac{V_2^2}{2g}$$

$$= 6.82\,\frac{V_2^2}{2g}$$

Substituting this in the Bernoulli equation above, we have

$$100 = 85 + (1 + 6.82)\,\frac{V_2^2}{2g}$$

The jet velocity is therefore

$$V_2 = \sqrt{2g\,\frac{15}{7.82}} = 11.1 \text{ ft/sec}$$

Since velocity head is 1.92 ft, the various head losses are found by multiplying this by the several terms in the above equation for h_L.

Elevations of points on the energy grade line are found by subtracting the head losses which occur up to the point of

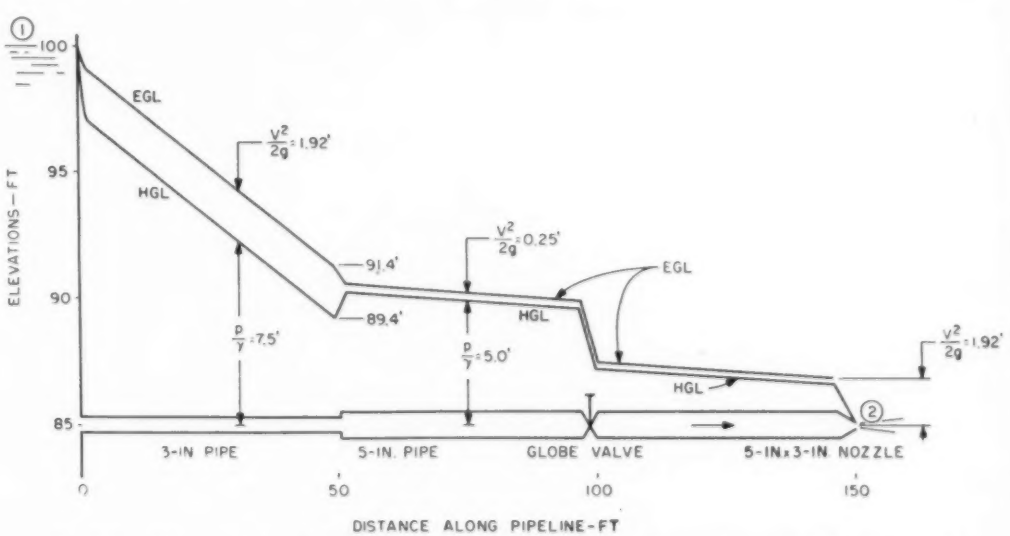

fig. 3 In solving a problem, start from known points and calculate changes along the pipe. Between sites of sudden change, energy and hydraulic grade lines can be drawn as straight lines.

interest from the reservoir elevation (100.0 ft). Thus, at the point just preceding the sudden expansion, the energy grade line elevation is

$$100 - (0.5 + 4.0)1.92 = 91.35 \text{ ft}$$

Determining the energy grade line elevation at each point of interest amounts to writing Bernoulli's theorem between the reservoir surface and the point in question. Elevations of the hydraulic grade line are found by subtracting velocity head in the pipe at the point in question from elevation of the energy grade line.

In the 3-in. pipe, velocity head is 1.92 and in the 5-in. pipe it is 0.248 feet. Thus, for the point calculated above, the hydraulic grade line elevation is 89.43 ft.

In this manner, the elevations of the two lines are determined at the points at which they change. Points of known elevation are then connected by straight lines, resulting in indications of the variation in energy and hydraulic grade lines as shown in fig. 3. Conditions at the sudden expansion in this figure illustrate a rise in the hydraulic grade line even though there is a loss in energy.

It is not always necessary to determine the locations of the hydraulic and energy grade lines as carefully as we have done here. Experience soon gives one a fair concept of how they vary, and sometimes, this may be all one needs to indicate what may occur in a pipeline.

Thus, for the flow situation depicted by fig. 2a, the variation in the two lines was apparent without any calculation.

Multipipe Systems

These pipeline problems were all concerned with several pipes in series. There is another class of pipeline problem, however, in which several pipes are connected in parallel, i.e., total flow is divided between several pipes.

Since the pipes usually have different resistances, we cannot easily state what fraction of the flow goes down any one pipe. Although the techniques for handling such problems are simple and rational they are not always self-evident.

Two fundamental rules or laws, corresponding to Kirchhoff's laws for electric circuits, are used to solve pipe network problems.

- The first is that the algebraic sum of the flows into a junction is zero, or the inflow into a junction must equal the outflow from it. This is no more than the continuity relation.
- The second rule is that with no pumps or turbines in any of the pipelines, the algebraic sum of the head losses around any pipe loop is the same. This loss relationship may also be stated in the form that between any two junctions, head loss is the same no matter by what pipe or pipes (i.e., path) it is computed.

In solving such pipe network problems, we treat the hydraulic and energy grade lines as being coincident. That is to say, the velocity head in any pipe is assumed negligible in comparison with the losses that occur.

In conjunction with our methods for calculating losses, these two hydraulic Kirchhoff's laws allow us to solve any combined pipe problem. Minor losses, when significant, are treated through conversion into equivalent lengths of straight pipe.

Two of the simpler kinds of problems encountered are the parallel-pipe system and the three-reservoir problem. In the first type, shown in fig. 4 for three parallel pipelines, the pipeline capacity is increased by placing several pipes in parallel between points A and B.

If the three pipes were identical in length, diameter and roughness, the problem would be easily solved. The flow would divide equally between the three. But since the pipes are rarely identical in resistance, the problem is finding how the flow is divided. In this case, the first of our Kirchhoff laws tells us that

$$\Sigma Q = Q_1 + Q_2 + Q_3 \quad (2)$$

while the second tells us that

→ *to next page*

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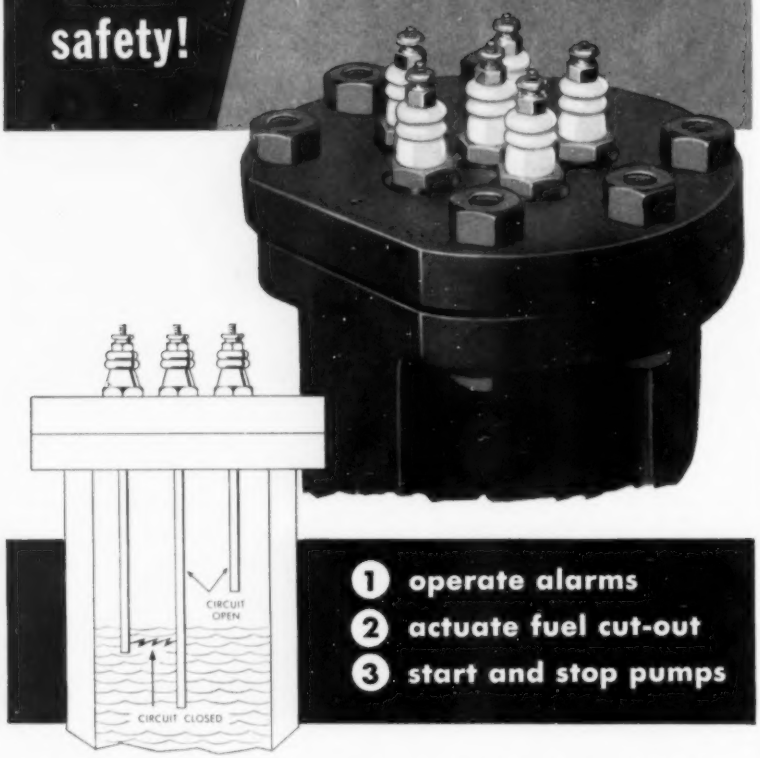

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$$h_{f_1} = h_{f_2} = h_{f_3} \qquad (3)$$

Our usual friction relation (eq. 1a) gives a set of equations relating Q and h_f for each pipe.

$$Q = \sqrt{\frac{h_f D^5 g}{fL} \frac{\pi^2}{8}} = K\sqrt{h_f} \qquad (1b)$$

Using the result of eq. 3 for the equality of the head losses and the expression for loss from eq. 1b, we can write eq. 2 as:

$$\Sigma Q = K_1\sqrt{h_f} + K_2\sqrt{h_f} + K_3\sqrt{h_f} = (K_1 + K_2 + K_3)\sqrt{h_f} \qquad (4)$$

To find head loss for a given flow or flow for a given head loss, we need only determine the various K values. Since D and L are specified by the problem, the only question is that of finding f.

This cannot be found directly and must first be estimated. The problem is first solved with estimated values of f and then a second approximation (which is usually close enough to the correct result) is made. If a different number of parallel pipes are involved, the only change in the solution is the use of a different number of K terms.

EXAMPLE: A 3-in. diam 300-ft pipe and a 4-in. diam 200-ft pipe are connected between points A and B in a long pipeline. How is a total flow of 1.6 cfs distributed between the two pipes and what is the head loss between points A and B?

SOLUTION: For simplicity, we will assume that the two pipes have the same friction factor, say f = 0.03. Therefore, for the 3-in. pipe,

$$K_1 = \sqrt{\frac{D^5 g}{fL} \frac{\pi^2}{8}} = \sqrt{\frac{0.25^5 \times 32.2 \times \pi^2}{0.03 \times 300 \times 8}} = 0.064$$

and for the 4-in. pipe, $K_2 = 0.165$.

From eq. 4 we have

$$\Sigma Q = 1.6 = (0.064 + 0.165)\sqrt{h_f} = 0.229\sqrt{h_f}$$

By eq. 1b, flow in pipe 1 is

$$Q_1 = 0.064\sqrt{h_f} = \frac{0.064}{0.229} \times 1.6 = 0.45 \text{ cfs}$$

cfs and that in pipe 2 (4-in. diam) is 1.15 cfs.

Head loss between A and B is $h_f = (1.6/0.229)^2 = 49$ ft.

The second of the two simpler kinds of multipipe problems may be termed the three-reservoir problem, although the number of reservoirs may differ from three. Fig. 5 illustrates this type of pipeline problem, in which three reservoirs of different elevations are connected by a set of pipelines.

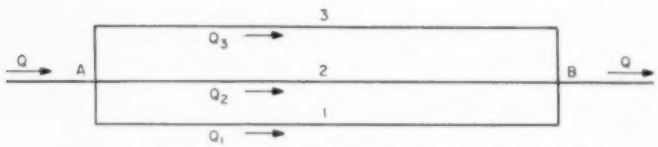


fig. 4 Multiple pipe networks, like electric networks, yield to treatment by Kirchhoff's laws.

It is usually obvious that the flow is out of one reservoir and into one of the others. For the third reservoir, the situation is not always so clear.

The actual flow direction in the pipe to this reservoir depends upon its relative resistance as well as the reservoir surface elevation. In this type of problem we must find the flow out of or into each reservoir.

Multiple reservoir problems are solved with the aid of our Kirchhoff laws and our relationships between flow and head loss (eq. 1). Thus, at the junction between the three pipes shown in fig. 5, the first or continuity law states that

$$Q_1 + Q_2 + Q_3 = 0.$$

The signs of these quantities are treated as positive if they represent an inflow to the junction, and negative if they are an outflow. The second or head loss law leads to relationships stating that the difference between the elevation of any reservoir and the grade line at the junction is equal to the pipe friction in

the joining pipeline.

To write this in equation form, it is necessary to decide on the direction of flow in each line. As has been noted, this may not be self-evident for one of the pipes (such as pipe 2 in fig. 5).

A decision in this matter may be reached by assuming flow in this line to be zero. This gives us a value for the grade line elevation at the junction, from which flow rates in the two other pipes can be calculated.

Comparison of the calculated flows into and out of the junction will then indicate the proper flow direction for the other pipe. Once the flow direction in all three pipes is known our head loss relationships (special forms of Bernoulli's Theorem) may be written. Thus, for pipes 1 and 3 of the situation shown in fig. 5 we have,

$$Z_1 = \left[\frac{p}{\gamma} + z\right]_J + h_{f_1}$$

$$\left[\frac{p}{\gamma} + z\right]_J = Z_3 + h_{f_3}$$

where subscript J indicates conditions at the junction, and 1 and 3 indicate the pipelines between the several reservoirs and the junction.

For the three-reservoir problem, the procedure outlined above leads to a series of four equations in terms of the three basic unknowns Q_1, Q_2, and Q_3, and the auxiliary unknown.

$$\left[\frac{p}{\gamma} + z\right]_J$$

A relatively simple procedure for solution of these simultaneous non-linear algebraic equations is a successive approximation approach in which values of

$$\left[\frac{p}{\gamma} + z\right]_J$$

are chosen.

In terms of the value for this factor, the head loss relationships indicated above can be solved for flow rates in the pipes with the aid of eq. lb. A check on the continuity relationship at the junction then indicates the nature of the next approximation, *i.e.*, whether

$$\left[\frac{p}{\gamma} + z\right]_J$$

should be assumed to be larger or smaller.

EXAMPLE: Three water reservoirs, such as shown in fig. 5, are at elevations 100, 60, and 30 feet, with pipelines of 6000 ft of 2-ft pipe, 2000 ft of 1-ft pipe and 3000 ft of 1.5-ft pipe, respectively. Find flows in the three pipelines.

SOLUTION: In an actual situation, it would be necessary to determine the friction factor by the methods already indicated, once (and probably twice) for each of the pipelines. However, rather than complicate our solution with this additional variable, we will assume that the friction factor for all three pipes is 0.02 and does not vary significantly for the various flows.

The solution is speeded by calculating K values (eq. lb) for each pipe, since these relate discharge to head loss. We find the following values

$$K_1 = 3.25$$

$$K_2 = 1.00$$

$$K_3 = 2.24$$

As our first approximation, we take

$$\left[\frac{p}{\gamma} + z\right]_J$$

equal to $Z_2 = 60$ ft which corresponds to $Q_2 = 0$. The flows in the other lines are therefore

$$Q_1 = 3.25\sqrt{h_{f_1}} = 3.25\sqrt{100-60}$$

$$= 20.5 \text{ cfs}$$

$$Q_3 = 2.24\sqrt{h_{f_3}} = 2.24\sqrt{60-30}$$

$$= 12.3 \text{ cfs}$$

The continuity relationship at the junction is therefore,

$$Q_1 + Q_2 + Q_3 = 20.5 + 0 - 12.3 = 8.2$$

Since this is greater than zero, the flow in pipe 2 must be negative, *i.e.*, away from the junction. The gradient elevation at the junction must be more than 60 ft which will also decrease Q_1 and increase Q_3.

As a second trial take

$$\left[\frac{p}{\gamma} + z\right]_J = 70 \text{ ft}$$

On solving for the flows and introducing them into the continuity relationship we get,

$$Q_1 + Q_2 + Q_3 =$$

$$17.8 - 3.2 - 14.2 = 0.4 \text{ cfs}$$

This error is within about 2% of the largest flow. Taking 71 ft as the next approximation, the error is reduced to −0.14 cfs, or less than 1%. The final solution is

$$\left[\frac{p}{\gamma} + z\right]_J = 70.7 \text{ ft}$$

for which the flows are

$$Q_1 = 17.6 \text{ cfs}$$

$$Q_2 = -3.3 \text{ cfs}$$

$$Q_3 = 14.3 \text{ cfs}$$

The three-reservoir problem and the previously discussed parallel pipe type of problem are relatively simple multipipe problems. Much more complex situations arise in pipe networks or distribution systems.

In such cases, we have many pipes and interconnected loops with inflows and outflows at numerous points. Application of our Kirchhoff laws to each loop and junction leads to a

→ *to next page*

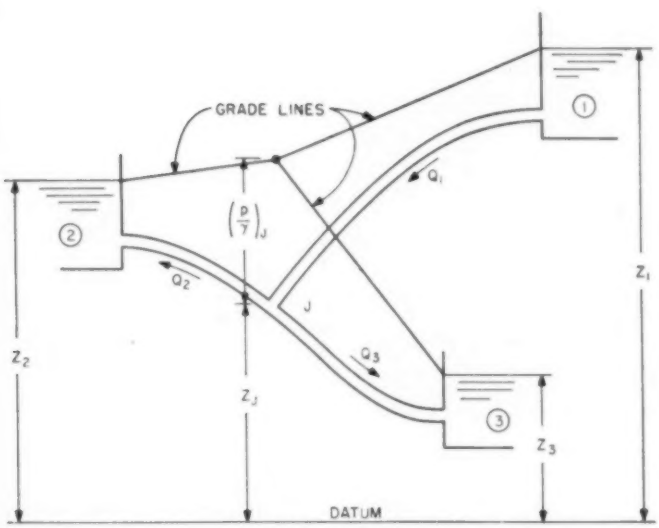
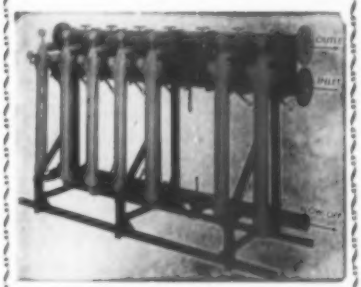


fig. 5 The "three-reservoir problem" can be solved by successive approximation using Kirchhoff's dictum that the sum of flows entering and leaving a point must be zero.

COST-CONSCIOUS FILTERS

save time in operation and servicing



1. Ronningen Model 208 Multiplex Filter (shown above) with 1 unit removed from line for service—and all the others can continue to operate.

2. All are Quick Coupling—Non Short-Circuiting. Sealed both ends. Each unit can be back washed and blown down in 5 seconds.

3. Heavy reinforced inner assures 150 PSI "dead short" without collapse.

4. Bronze and copper construction; also all 316 stainless steel; also all steel.

10-3000 GPM. Pressures to 300 PSI.

Write for Bulletin 954P

STRAIN AGAIN WITH RONNINGEN

"Particles large or small, we filter them all"

RONNINGEN-PETTER CO.

Vicksburg, Michigan Phone Midway 5-5161

Representatives throughout U. S. and Canada

Circle 1426 opposite last page.

When the PRESSURE is on...

WILCOX Self-Sealing GASKETS HOLD

The greater the pressure, the tighter it holds. Nothing can beat this Wilcox Self-Sealing Gasket as proved in years of service.

The U-shaped metal outer cover is packed with a resilient filling (usually rubber or asbestos). Pressure exerted on the elastic filling forces it into the cover, putting force against the adjacent flange surfaces. Thus, pressures that tend to blow ordinary gaskets make the Wilcox tighter.

Available with covers of copper, lead, tin, aluminum, monel, stainless steel, etc., in all sizes, standard or special.

Write for Bulletin No. 569 and prices

CHICAGO-WILCOX MFG. CO.

7725 South Avalon Avenue
Chicago 19, Illinois

Circle 1427 opposite last page.

Regulate and control electric power

for any manufacturing process

better, accurately, efficiently, with Sorgel saturable reactors

The control can be a small, manually operated, stepless adjusting auto transformer which can be placed in any desirable location, or it can be automatic.

Available in ratings of 1 Kva to 1000 Kva single phase. 3 to 3000 Kva poly-phase. All voltages up to 15,000 volts.

Sorgel reactors are designed to meet your exact requirements. Let us know what your problems and requirements are, and we will submit our recommendations with complete information.

●

Also a complete line of

dry-type transformers

¼ Kva to 2500 Kva single phase.
1 Kva to 3000 Kva poly-phase.
All voltages up to 15,000 volts.

●

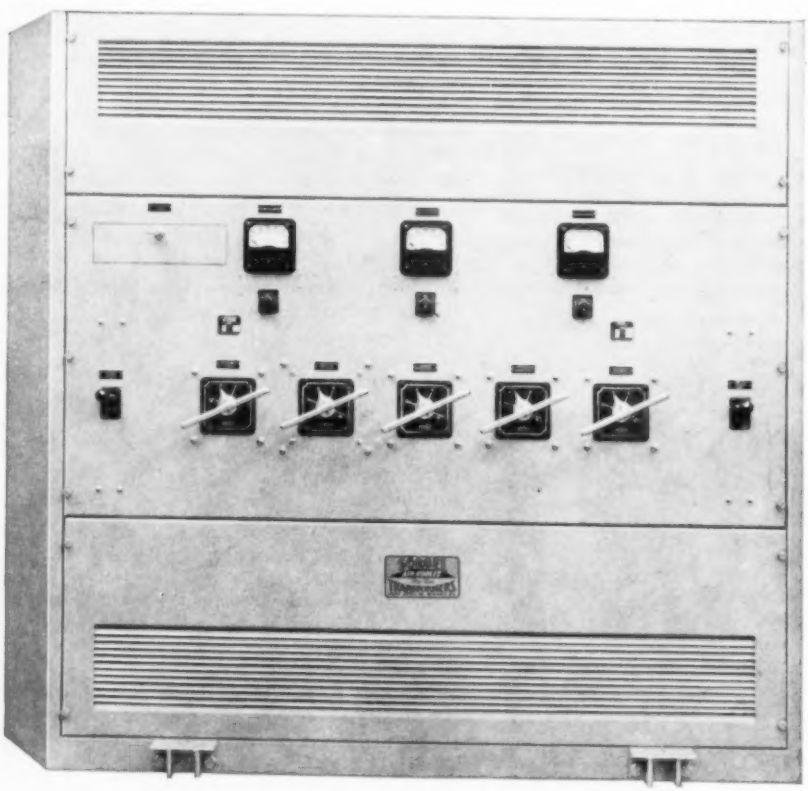
Substations

Sorgel transformers, either dry-type or Askarel-cooled, are incorporated in substations, complete with primary or secondary switchgear. They are procurable with any type or make of switchgear, and from any substation manufacturer.

Some typical applications:

Electric furnaces.
Electric heat treating equipment.
Glass melting equipment.
Metal melting equipment.
Electric ovens.
Dimmers for incandescent and infra-red lamps.
Variable speed motors.

15 Kva, single phase, 60 cycle Saturable Reactor with voltmeter, ammeter, D.C. supply and manual control.



470 Kva, three phase, saturable reactor — Transformer combination with circuit breakers and metering. Tap switches on transformer and reactor provide controlled load voltage in six ranges.

SORGEL ELECTRIC CO., 841 West National Ave., Milwaukee 4, Wisconsin

Circle 1428 opposite last page.

Power Basics

← *from preceding page*

staggering array of simultaneous equations.

It is impracticable to solve these by conventional methods and we have found other ways of reaching the desired answers. For electrical networks the network analyzer has been developed — and a similar approach is possible for fluid flows, although it is complicated by the non-linear resistances encountered.

Suitable non-linear network analyzers have been developed and permit rapid solutions.

A numerical or relaxation method for solving network problems was indicated by Hardy Cross in 1936. The basic approach is to assume a reasonable distribution of flows in the various pipes, satisfying the continuity relationship at each junction.

A correction is then calculated and applied to the flow in each loop, in accordance with the head loss relationship. After all loops are corrected, revised flows in each pipe are calculated and the procedure repeated.

The final solution, of course, satisfies the hydraulic Kirchhoff laws and the discharge-head loss relationship to a reasonable degree of approximation. ●

"Just a little free sample . . ."

Economy in a Whisper

← from page 23

rooms or offices adjacent to the boiler room. There, a grill, wall panel, other equipment, or structural unit may act as a secondary sounding board.

Self-contained boiler units are mounted on metal bases, which run the length of the boiler. Steel channels were separated by series of sandwich-like layers of rubber vibration-absorbing strips. The channels support the boiler on the long sides of its rectangular base. The rail sandwiches are placed in trenches so that the tops extend just above floor level.

Thus, the boilers rest on a cushion that absorbs all shocks that might be transmitted to the floor.

Combustion noises are minimized by air-intake mufflers. Since the rest of each package boiler is sealed, only noise source is the air intake itself.

To muffle all air-handling noises, box-type blower silencers used with the boilers cover the double intake fans. The boxes are lined with acoustical material and equipped with a similarly coated baffle plate. Most of the sound is thus absorbed.

As further insurance against noise transmission, all piping connected with the three boilers is attached to ceiling and walls with vibration-damping hangers. Also, stacks are covered with insulating material.

To complete boiler room noise reduction, a hanging ceiling, made of metal furring and lath, is suspended about one foot below the concrete floor construction of the rooms above. This ceiling was actually installed as a heat insulator rather than noise-insulating medium. The ceiling is plastered with a one-inch thick layer of Vermiculite.

These techniques of stopping noise at its source and blocking its transmission have worked to the complete satisfaction of local school operating people and officials. Sound level tests indicate the complete elimination of objectionable boiler room noises.

(Boilers used at Massapequa are products of Orr & Sembower, Morgantown Rd., Reading, Pa.)

Circle 1429 opposite last page.

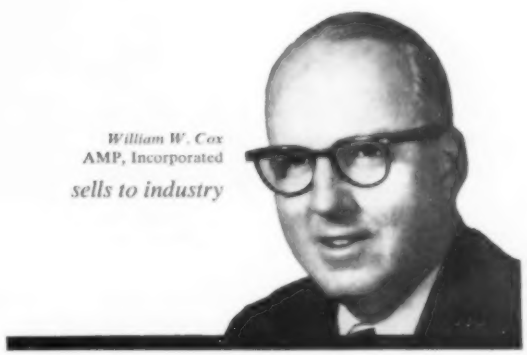
Can specialized business publication advertising actually sell?

By reputation, salesmen are reluctant to credit anything but their own selling efforts for getting names on the dotted line.

Actually, it's quite a different story. The most successful salesmen will tell you two important things about selling. 1. That the selling process is largely a matter of communicating ideas. 2. And that specialized business publication advertising can help importantly to register information with prospects.

Of course each salesman will express this in his own way . . . but they all agree that selling would be far more difficult without the advertising that appears in the industrial, trade, and professional publications that serve the specialized markets to which they sell.

Here, for instance, is what a salesman has to say about this kind of advertising:



William W. Cox
AMP, Incorporated
sells to industry

Says Mr. Cox:

"The quickest way we can introduce a product is by introducing it through advertising in business papers. That way we get it around faster than we can by word of mouth alone. On occasion my home office has inquiries out to me before I can get to the customer or prospect to introduce a new product. They've already seen it in a trade magazine.

"It's interesting to note that within the last two weeks I received a survey which shows about 80% of the new customers we get on our books come through our trade publication advertising. Of course, our company is only 15 years old and we have grown from what you might say, *nothing*, to the biggest in our business. Certainly a lot of that has come from our advertising campaigns. Our name is known throughout the world right now, purely because of our advertising program. When I go to a prospect now, they know my company, they know my product . . . it makes my job easier, and opens doors when I have to make cold calls."

Ask your own salesmen what your company's business publication advertising does for them. If their answers are generally favorable you can be sure that your business publication advertising is really helping them sell. If too many answers are negative it could well pay you to review your advertising objectives—and to make sure the publications that carry your advertising are read by the men who must be sold.

How salesmen use their companies' advertising to get more business

Here's a useful and effective package of ideas for the sales manager, advertising manager or agency man who would like to get more horsepower out of his advertising. Send for a free copy of the pocket size booklet entitled, "How Salesmen Use Advertising in Their Selling," which reports the successful methods employed by eleven salesmen who tell how they get more value out of their companies' advertising.

You'll find represented many interesting variations in how they do this. Some are very ingenious; all are effective. You can be sure that more of your salesmen will use your advertising after they read how others get business through these simple methods.

The coupon is for your convenience in sending for your free copy. Then, if you decide you want to provide your salesmen with additional copies, they are available from NBP Headquarters in Washington, at twenty-five cents each. Or if you choose you can reprint the material yourself and distribute it as widely as you please. But first, send for your free copy.

NATIONAL BUSINESS PUBLICATIONS, INC.
Department 4D
1413 K Street, N. W.
Washington 5, D. C. STerling 3-7533

Please send me a free copy of the NBP booklet "How Salesmen Use Advertising in Their Selling."

Name _____

Title _____

Company _____

Street Address _____

City _____ Zone _____ State _____

National Business Publications, Inc.

NBP

. . . each of which serves a specialized market in a specific industry, trade or profession.

NEW DEVELOPMENTS

High-pressure gage can't cloud, crack

Boiler water-level gage for pressures over 750 psi won't cloud or explode; can operate automatic controls. Similar to conventional gages in size and shape, new gage has non-magnetic stainless-steel pipe enclosing a metal float and magnet.

Steel pipe replaces conventional glass or quartz tube that is subject to breakage and clouding from high temp.

Magnet acts upon metal reeds mounted outside tube walls. Reeds can carry electric contacts to operate automatic water controls or activate alarms. Valves disconnect gage from boiler if a leak or other trouble develops.

Steel pipe replaces sight glass. Magnet and reeds indicate level

(Steam-boiler water-level gauge is manufactured by Charles Engelhard, Inc.; 850 Passaic Ave.; East Newark, N. J.)
Circle 1430 opposite last page.

For more information on items reported in the New Developments section, circle corresponding numbers on reader service card opposite last page.

Constant-level oilers have easy-to-fill cap

Constant-level oiler for ring-oiled and anti-friction bearings, pillow blocks, gear boxes, and pump housings is filled through a top filler cap without removing reservoir. Oiler maintains a constant level. May be remote-mounted when an adjustable oil level is desirable or when a bearing vibrates excessively.

Lucite or glass reservoirs are available. Oiler capacities are 2 ounces to 1 gallon.

(Model CR constant-level oilers are manufactured by Oil-Rite Corp.; 2396 Waldo Blvd., Manitowoc, Wis.)
Circle 1431 opposite last page.

Oil switches for manual operation

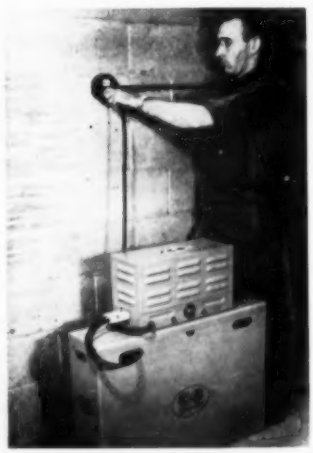
Ratings for type VM, VH, and VR oil switches at 7.2 kv are 400 amps for lagging power factors over 75%, 200 amps for lagging power factors of 50 to 75%, and 100 amps for lagging power factors of 10 to 50%. At 14.4 kv, switching ratings are 200, 100, and 50 amps respectively for lagging power factors of 75 to 100, 50 to 75, and 10 to 50%. Units switch up to 300 amps of capacitive current.

VM models have a manual-remote handle and VH models are equipped for hook-stick operation. The three-phase switches are rated 15 kv, 400 amps, and 110 kv.

(Manually operated oil switches are manufactured by Line Material Industries, McGraw-Edison Co., Milwaukee 1, Wis.)
Circle 1432 opposite last page.

Truck battery chargers plug into 110 v line

Single-phase, constant voltage silicon rectifier battery chargers plug into any standard 15-amp, 115-volt outlet. Small unit will charge any 6-cell lead-acid battery to 480-amp hr capacity; larger unit, any 6-cell lead-acid battery to 660-amp hr capacity.



Silicon rectifier charges six-cell batteries from 110 v ac line

Charging takes about 16 hours; design prevents battery overcharge.

(Truck Battery Chargers are manufactured by C & D Batteries, Inc., Washington & Cherry Sts., Conshohocken, Pa.)
Circle 1433 opposite last page.

Records operations in sequence

Millisecond operations recorder (MOR) automatically records all equipment operations sequentially on a printed log sheet. Log sheet aids in evaluating normal operations and in spotting trouble. MOR operates from regular station trouble contacts—often contacts operating existing annunciators can operate MOR system simultaneously in parallel.

Provides tape (at top) record of what happened and when

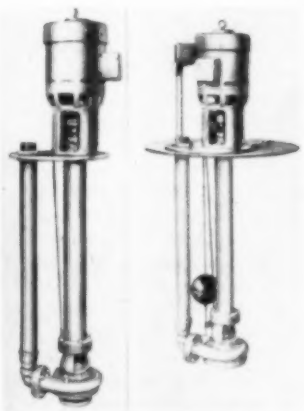
Standard 3-inch digital recording tape is printed with date and time of event, number of trouble contact involved, direction of change. MOR unit is completely transistorized.

(MOR system recorder is manufactured by Fischer & Porter Co., Hatboro, Pa.)
Circle 1434 opposite last page.

Centrifugal pumps for sump, process use

Heavy-duty vertical and centrifugal pumps for sump and process service have capacities to 1080 gpm with heads to 290 feet for pit depths to 20 feet. Line includes single and duplex units in wet and dry types.

Sump pumps may be



Process and sump models handle up to 1080 gpm

adapted in the field for changed pit depths or pump ratings by substituting new standardized parts. Vapor-proof and corrosion-resistant construction is available.

(Heavy-duty sump pumps are manufactured by Goulds Pumps, Inc.; 38 Black Brook Rd., Seneca Falls, N. Y.)
Circle 1435 opposite last page.

Alarm sounds warning when coal is low

Coal-alarm system sounds warning when coal supply runs low or arches. Magnetic switch receives impulses from a magnet mounted on the pulverizer or stoker shaft. This transmits electric impulses to an electric stop counter that registers each feeder revolution.

Alarm setting is based on feeding capacity per feeder revolution. Since signal is dependent only on fuel consumption, alarm signal is always in step with boiler load, despite load fluctuations.

(Coal-Alarm system is manufactured by Richardson Scale Co.; Clifton, N. J.)
Circle 1436 opposite last page.

Plug-in busway installs fast

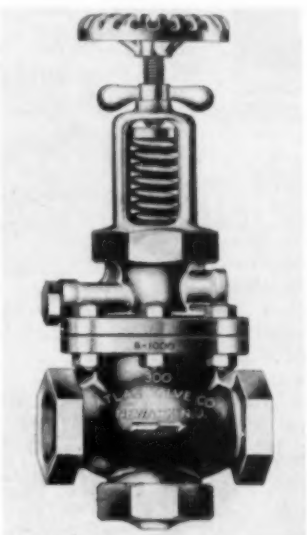
Simple joint construction of plug-in busway speeds installation time— busway overlap pressure joint is joined mechanically and electrically by tightening six captive screws.

Designed for use where plug-in outlets over a wide area are necessary, new busway can be hung on 10-foot centers in edgewise position. Can also be used as a feeder for lighting systems or branch circuit from switchboard. Busway is rated 100 amps, 600 volts maximum, three- and four-wire construction.

(Type DH plug-in busway is manufactured by General Electric Co., Plainville, Conn.)
Circle 1437 opposite last page.

Reducing valves have stellited seats

Pressure reducing valves now have stellited main valve in addition to stellited pilot valve and pilot seat. This valve is spring-loaded and piston actuated by an internal pilot. It handles inlet pressures to 1500 psi at 900°F and reduces to pressures as low as ½ psi in one stage.



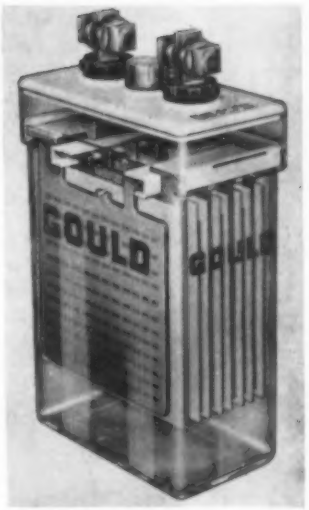
Valve is rated for 1500 psi, 900° F service

(Type B reducing valves are manufactured by Atlas Valve Co., Newark 5, N. J.)
Circle 1438 opposite last page.

Stationary batteries take less space

Lightweight, space-saving batteries for 40 to 960 amp-hr are designed for standby emergency power for switchgear, alarm systems, telephones, controls, signals, and emergency lighting.

Plastrite jar is lightweight and saves 30 to 40% in floor space over conventional containers. Jar will not bulge or warp under heat. Acid-proof seal eliminates seepage, prevents corrosion and wet covers.



Plastic batter jar saves one-third of floor space

(Lightweight batteries are manufactured by The Industrial Div., Gould-National Batteries, Inc.; Trenton 7, N. J.)
Circle 1439 opposite last page.

White anti-rust paint aids light reflection

White anti-rust paint protects interior metal-work where high humidity or production fumes and vapors cause metal deterioration.

Needs no prime coat

White color reflects more light for added brightness.

It needs no prime coat—applies over deteriorated metal surfaces without sandblasting. Also applies over wood and cement.

(White Rustrem anti-rust paint is manufactured by Speco, Inc., Cleveland 9, Ohio.)
Circle 1440 opposite last page.

Transmission seals out dusty atmospheres

Heavy-duty transmission has self-contained pump and filter along with special oil seals to keep out abrasive dust. Transmission has capacity to 150 hp direct-connected to motor entering transmission at 3470 rpm.

Four speed changes are available with a step-up ratio 1:3 overall or a reduction to 10: 1 overall.

(Heavy-duty transmission 14800-PF is manufactured by Western Manufacturing Co., 3400 Scotten, Detroit 10, Mich.)
Circle 1441 opposite last page.

Three armored cables need no conduit

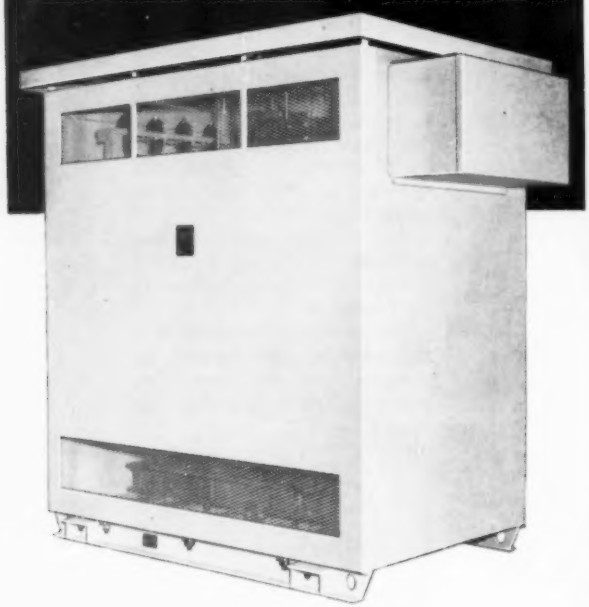
Interlocked armored cable in 600-, 5000-, and 15,000-volt ratings has galvanized steel, aluminum, or bronze covering. Cable may be used internally for power and lighting, motor, control, or overhead circuits.

From 600 to 15,000 volts

Cable is used with troughs, racks, or ladders to permit a more flexible arrangement than is possible with conduit. Armored cable offers high resistance to harmful chemical action.

(Interlocked armored cable is manufactured by Rome Cable Corp.; Rome, N. Y.)
Circle 1442 opposite last page.

Quick Delivery on SPECIAL TRANSFORMERS AND LOAD DISTRIBUTION CENTERS



When you need transformers with special voltage ratings, special taps or special accessory switch gear, send the specifications of your requirements to Acme Electric.

Our facilities for producing "Special Transformers" often permits us to make shipments months ahead of usual delivery schedules.

We can "ship from stock" most popular size standard transformers. Special ratings from 1/10th to 225 KVA, single phase, and 9 KVA to 750 KVA, 3 phase, shipped promptly. When you need dry type power or distribution transformers in a hurry — write or wire.

ACME ELECTRIC CORPORATION
521 WATER STREET • CUBA, NEW YORK

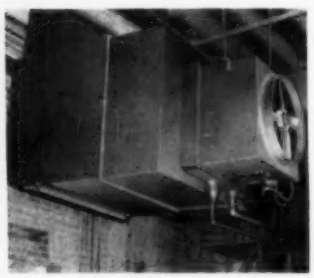
Acme ACME Electric
TRANSFORMERS

Circle 1443 opposite last page.

NEW DEVELOPMENTS

Equalize negative air pressures

Air make-up unit maintains proper balance of supply and exhaust air when exhaust fans are used. Unit eliminates creation of semi-vacuum that would cause forced infiltration of cold air around windows and doors.



Air capacities range from 4000 to 33,000 cfm

Basic unit consists of a fan and coil assembly with fan mounted in a plenum on discharge side of coil. Available in six sizes from 24 inches to 54 inches. Air capacities range from 4000 cfm to 33,000 cfm.

(Air make-up unit is manufactured by Aerovent Fan Co., Inc.; Piqua, Ohio.)
Circle 1444 opposite last page.

Fits same NEMA frame as standard motor

Synchronous induction motor is the first built in same NEMA frame size as standard motor of equal horsepower. It accelerates as an induction motor but runs at exact synchronous speed without permanent magnets or dc excitation.

Ideal for applications requiring constant speed with varying load. As a conveyor drive, motor makes it possible to have an exact constant-speed or adjustable-speed system from no-load to full-load with a minimum of driving units and controls.

Motor is unaffected by voltage fluctuations, so is ideal for precision timing and metering devices and for recording instruments.

Sizes from 1 to 100 hp in

One dependable quality

Manarch
renewable fuses

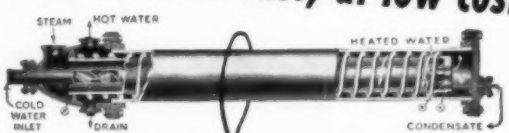
From raw material to final inspection every part is MADE and ASSEMBLED under our own quality control.

STRATEGICALLY LOCATED WAREHOUSE STOCKS

Manarch ELECTRIC CORPORATION
Jamestown, New York

Circle 1445 opposite last page.

STEAMLINED! to heat water fast, at low cost



In the Johnson Heater, water to be heated is routed first inside, then outside, a blanket of live steam. It's full pressure steam, too; up to 150 lbs., or 250 lbs. in heavy duty types, no reducers are needed. The result: faster, more efficient heat transfer for a unit of its size. No wonder industry has found so many applications for the Johnson "Instant" Heater, in heating water and process liquids of various types.

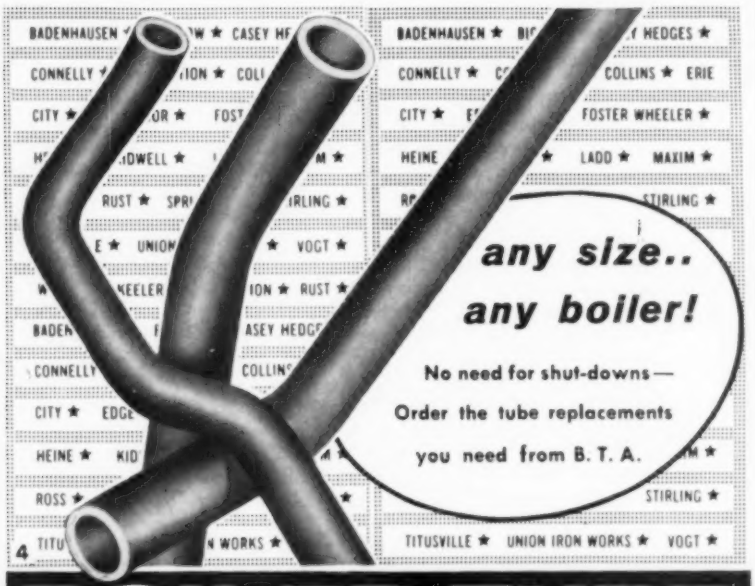
JOHNSON "Instant" HEATER

Sizes for all needs; write for literature

The Johnson Corporation
807 Wood St. Three Rivers, Mich.

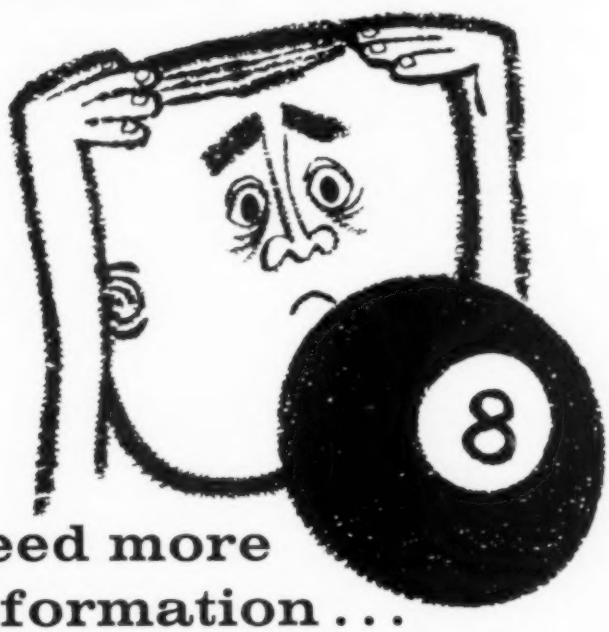
Circle 1446 opposite last page.

Replacement Tubes



BOILER TUBE
COMPANY OF AMERICA
McKEES ROCKS, PA. (Pittsburgh District) Federal 1-7750

Circle 1447 opposite last page.



need more information . . .

Note there is a key number at the end of editorial articles or advertisements. To request more information circle the proper number on the convenient form opposite the last page. Send the form to us . . . we do the rest. Information comes direct to you. No obligation, of course.

any standard enclosure and can be foot- or flange-mounted. Wide range of mechanical modifications are available for specific application requirements.

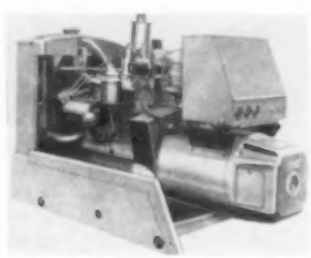
One to 100 hp synchronous motors are no larger than standard

(Synchro-Spede Motors are manufactured by Louis Allis Co., 427 East Stewart St., Milwaukee 1, Wis.)
Circle 1448 opposite last page.

Electric plants reliable for standby power

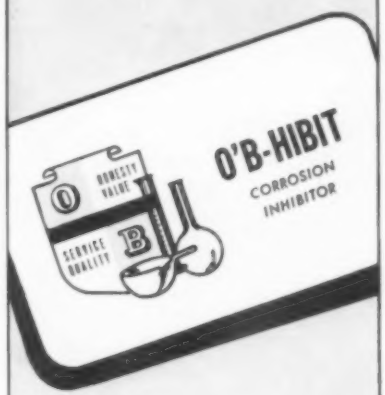
Water-cooled, revolving-armature 10- and 15-kw electric plants provide full-rated electric power wherever dependable, quick-starting auxiliary power is needed.

Prime mover is heavy-duty 41-hp Continental F-162 engine that operates on gasoline or gaseous fuel. Self-aligning generator gives voltage regulation of ± 5%, with frequency regulation of 3 cycles maximum.



Voltage regulation is ± 5%, frequency regulation is ± 3 cycles

(Model HC standby electric plants are manufactured by D. W. Onan & Sons Inc.; 2515 University Ave. S. E., Minneapolis 14, Minn.
Circle 1449 opposite last page.



If you use ACID CLEANERS look for this label . . . .

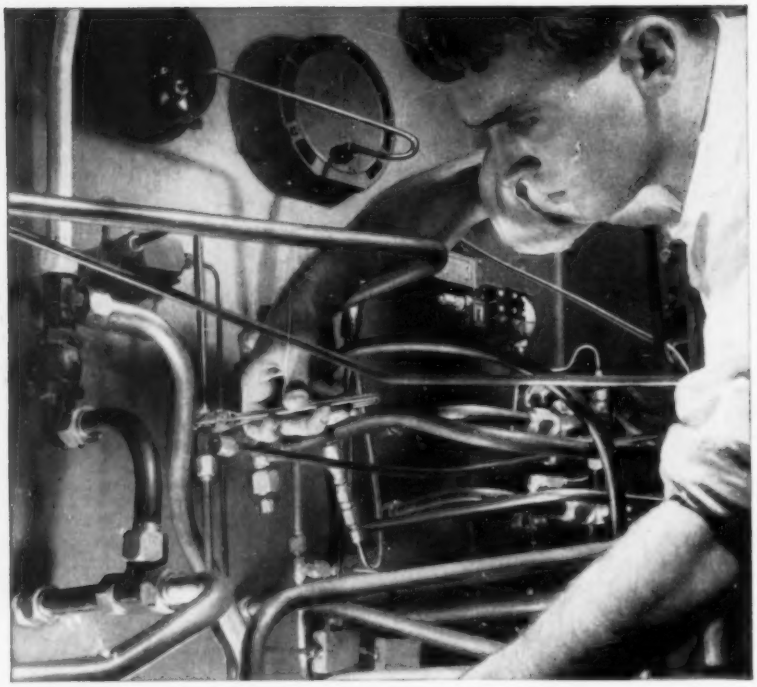
The manufacturer of an ACID CLEANER who displays this label on his product indicates he is using the finest Corrosion Inhibitor available.

For complete information on O'B-HIBIT and a list of manufacturers in your area who display this label, write:

O'B-HIBIT
P. O. Box 72
Caldwell, N. J.
Gentlemen:
Please send complete information on O'B-HIBIT Corrosion Inhibitor.

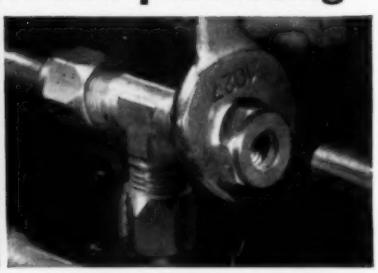
Name .....
Address .....

Circle 1450 opposite last page.



Fast, easy assembly with *Triple-lok* fittings even in close quarters, because of the low assembly torque. Yet *Triple-lok* remains absolutely leakproof under the severest conditions of vibration, high pressures and temperatures. *Triple-lok* is the flare fitting, famous for its sleeve — the industrial standard tube fitting. Meets specifications of the A.S.M.E. Code for Pressure Piping. Stocked in brass, steel, stainless steel, aluminum alloy. Made in other materials on special order. Send for Catalog No. 4310.

Easy-to-use Parker tube fittings for instrumentation and processing



Weld-lok. Easy to use. Simply insert tube, then weld. For extreme temperatures or corrosion conditions — wherever permanently welded joints are needed. Available in steel and stainless steel. Send for Catalog No. 4370.

Intru-lok. 3-piece flareless design fitting especially for instrumentation lines of ¼" through 1" O. D., copper or aluminum. Easy to install. Just insert tube, then tighten with regular wrench. Also for plastic tubing. Catalog No. 4324.

Warehouse stocks in industrial centers.
Ask your Parker Distributor — or write to:

PARKER FITTINGS AND HOSE DIVISION

Section 437-O, Parker-Hannifin Corporation, 17325 Euclid Ave., Cleveland 12, Ohio

Parker Hannifin
creative leader in fluid systems

Circle 1451 opposite last page.

Instrument can analyze four process streams

Gas chromatography analyzer analyzes as many as four process streams containing natural gases, vapors, low-boiling-point liquids, and hydrocarbons, with eight such components in each stream.

Assembly consists of an explosion-proof analyzer unit, a programming unit, and an eletronic recorder. Unit functions include: analyzer unit temperature control from 50 to 120° C with accuracy of ± 0.1° C with ambient swings to 60° F; air circulation system without blower motors; and detectors with low-volume cells with hot wire filaments.

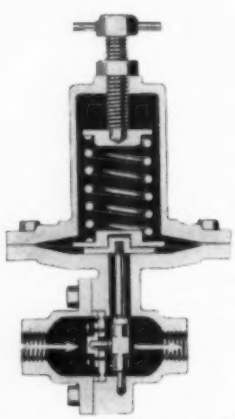
Programming unit gives complete controls to perform an analysis; continuous peak attenuation of each component being measured; and activation of recorder chart advance. Recorder draws either a bar record or a spectrum of an analysis.

(Chromomax analyzers are manufactured by Leeds & Northrup Co.; 4934 Stenton Ave., Philadelphia 44, Pa.
Circle 1452 opposite last page.

Design regulator valves for corrosive services

Sliding-gate regulator and control valves are now available in monel and aluminum for corrosive fluids. Valves handle steam, air, water, oil, gas, and chemicals. Services include pressure reducing, temperature control, diaphragm motor, sampling, and mixing.

(Sliding gate regulator and control valves manufactured by Jordan Industrial Sales Div., OPW CORP., Cincinnati 13, Ohio.)
Circle 1453 opposite last page.

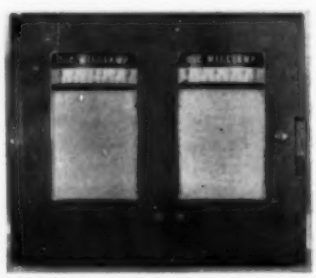


Regulating valve uses monel or aluminum construction

Combine 2 recorders in single panel

Designed to save panel space, Twin recorder has two CH recorder chart carriages and measuring elements in single case. Mounts on a 19-inch relay rack.

Features include 28 different chart speeds from ¼- to 120-in/min, throwaway plastic inkwell, 150-foot record rolls. Chart carriages are driven by motor in right-hand carriage.



Two recorder instrument mounts in a 19-inch rack

(Twin Recorders are manufactured by General Electric Co.; Schenectady 5, N. Y.)
Circle 1454 opposite last page.

LS belt design cuts V-belt whip

Length-stabilized V-belts for oil rig pumps and other long-center industrial drives are precision-proportioned to eliminate V-belt whip and other causes of belt turnover that result in eventual belt failure.

Belt compression area and strength members are redesigned—giving a high degree of lateral and longitudinal stability. High tensile strength synthetic belt fabrics are pre-

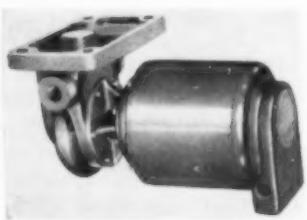
formed before vulcanization to preserve precision balance.

Highly sensitive electronic vibration analyzer factory-tests belts for any imperfections that could cause excessive belt vibration on the drive. Belts are vacuum-packed to keep belt length stabilized.

(Condor LS Belt is manufactured by Manhattan Rubber Div., Raybestos-Manhattan, Inc.; Passaic, N. J.)
Circle 1455 opposite last page.

Pump discharges in 3 directions

Outside flange mounted pump has three discharges (right side, left side, and through inlet port of mounting flange) that may be used in-



Outlets may be used individually or simultaneously

dividually, in pairs, or simultaneously. Handles capacities to 30 gpm and heads to 27 feet.

(Rumaco outside flange mounted Pumps 5S-4520 are manufactured by The Ruthman Machinery Co.; Cincinnati 2, Ohio.)
Circle 1456 opposite last page.

Coolant hose handles high temperatures

High-temperature hose for dielectric coolant is corrosion-proof, non-swelling, non-contaminating, gives excellent high-voltage insulation, yet contains no metal reinforcement that could render it a conductor.

Hose can be used for coolant lines on large electric generators in utility or industrial power houses, and in the production of high-power transformers and similar equipment. Flex-life vibration resistance, and chemical inertness of tube compound make it resistant to deterioration, indicating a possible service life of up to 30 years.

(Fluoroflex R536 hose is manufactured by Resisto-Flex Corp., Roseland, N. J.)
Circle 1457 opposite last page.

Exchange reactors are disposable

Disposable nuclear ion exchange reactors for use with nuclear grade ion exchange resins will exchange radioactive ions for non-radioactive ions to produce water essen-

When expended, unit is capped and disposed of

tially free from radioactivity.

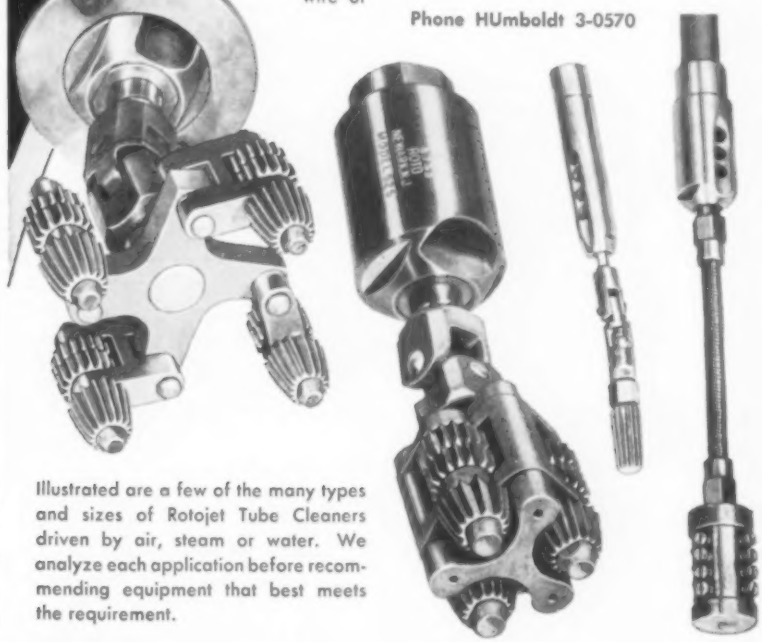
When reactor's capacity for removing radioactivity is reached, unit is disconnected, capped, and disposed of.

(Disposable Nuclear Ion Exchange Reactors are manufactured by Belco Industrial Equipment Div., Bogue Electric Manufacturing Co.: 100 Pennsylvania Ave., Paterson 3, N. J.)
Circle 1458 opposite last page.

ROTOJET®
Cleans TUBES and PIPES
ANY SIZE
from ½" to 12" I.D.
STRAIGHT or CURVED

Roto engineers are constantly designing new equipment to meet new conditions and applications for its tube cleaners. If you have a pipe or tube cleaning problem, we will be pleased to place our long specialized experience at your disposal. Write, wire or

Phone HUmboldt 3-0570



Illustrated are a few of the many types and sizes of Rotojet Tube Cleaners driven by air, steam or water. We analyze each application before recommending equipment that best meets the requirement.

ELLIOTT COMPANY—ROTO PLANT
DIVISION OF CARRIER CORPORATION
Tube Cleaner Specialists Since 1910
151 Sussex Avenue, Newark, N. J.

Circle 1459 opposite last page.

NEW LITERATURE

Reviews of books and industrial bulletins describing equipment, supplies, services

Synthetic lubricant for compressors

Bulletin describes a fire-resistant synthetic lubricant for air compressors.

With an auto-ignition temperature of over 1100°F, the lubricant lowers chance of flash fires and explosions by reducing carbon deposits and resisting oxidation — two basic causes of fires and explosions in air compressor systems.

Fewer carbon deposits also permit longer system operation between clean-outs.

Sixteen pages "Pydraul AC", is issued by Organic Chemicals Div., Monsanto Chemical Co., 1700 S. Second St., St. Louis 24, Mo.)
Circle 1460 opposite last page.

Steel weld caps— how to order

Covers ellipsoidal steel weld caps for pipelines, pressure vessels, and headers. Gives complete mechanical specifications. Two pages.

(Folder WC-1 is available from Henry Vogt Machine Co., 10th & Ormsby St., Louisville 10, Ky.)
Circle 1461 opposite last page.

What do you want in a pipe dope?

Answers to 29-question survey designed to establish what users want in a pipe connection sealer are given in bulletin.

Over 900 companies were asked to detail their requirements in regard to pressures, temperatures, fluids, and installation.

According to survey, 98.9% responding felt that ideal pipe fitting should seal with pressure and maintain seal under vibration.

(Eight-page study is issued by Flick-Reedy Corp., 2040 N. Hawthorne Ave., Melrose Park, Ill.)
Circle 1462 opposite last page.

Application data on protective relaying

"Applied Protective Relaying is basic text on protective relay systems applications, setting, and maintenance.

Book is an outgrowth of classes on relay applications. Subjects include technical tools; generator, motor, transformer, and station bus protection; system stability; testing and maintaining protective relays.

(To obtain "Applied Protective Relaying," 239 pages, — $3.00 direct to Westinghouse Electric Corp., Box 2278, Pittsburgh 30, Pa.)

"Now tell us exactly HOW you got stuck in the condenser!"

Instrument measures draft and pressure

Indicator is a multi-point instrument for measuring draft, pressure, and differential. Bulletin describes units available, optional signals and alarms, installation details.

(Eight-page bulletin is issued by Hagan Chemicals & Controls, Inc., 323 Fourth Ave., Pittsburgh 30, Pa.)
Circle 1463 opposite last page.

Manual gives data on chain drives

Book contains detailed engineering data on silent chain drives. Covering range from fractional hp drives in small power tools to huge drives transmitting thousands of horsepower, book includes service factor tables, ratings, chain length, and center distance computation.

Reviews pre-engineered stock drives, how to select engineered drives, wheel tolerances, drive components.

(88-page book — No. 2425 — is issued by Link-Belt Co., Prudential Plaza, Chicago 1, Illinois.)
Circle 1464 opposite last page.

Performance data on fluorescent lights

Eight-page bulletin reviews fluorescent lighting equipment for commercial and industrial lighting systems.

Includes complete dimension data and tables giving coefficients of utilization for fixtures, troffers, and ceiling systems.

(Bulletin 32a is issued by Smithcraft Lighting, 233 Everett Ave., Chelsea 50, Mass.)
Circle 1465 opposite last page.

Corrosion resistance of pipe materials

Dielectric values, power factor, volume resistivity, mechanical and thermal properties of PVC pipe are given in bulletin.

Chart classifies corrosion resistance rating of Types I and II PVC, low carbon steel, three classes of stainless steel, cast iron, aluminum, copper, red brass, lead, monel, and inconel with 383 chemicals. Thirty pages.

(Bulletin is issued by A. M. Byers Co., Clark Bldg., Pittsburgh, Pa.)
Circle 1466 opposite last page.

Accurate controls for atomic plants

"The Power Plant of Tomorrow" describes magnetic liquid-level and flow controls used on the Experimental Boiling Water Reactor at Argonne National Laboratories.

While book is concerned with controls for atomic power plants, control applications apply to industry today.

(Bulletin EBWR—1, 10 pages, is issued by Magnetrol, Inc., 2110 S. Marshall Blvd., Chicago 23, Ill.)
Circle 1467 opposite last page.

Dimension charts show cast steel gates

Bulletin describes 150-pound and 300-pound cast steel gate valves. Includes dimension and weight charts and line drawings of each valve.

(Four pages. Issued by Walworth Co., 60 E. 42nd St., New York, N. Y.)
Circle 1468 opposite last page.

Cochrane
MULTIPORT RELIEF VALVES
FOR STEAM • AIR • GAS SERVICE

- GUARANTEED OPERATION
- SIMPLE POSITIVE OPERATION
- MAXIMUM SAFETY
- NO JAMMING
- NO STICKING
- NO FREEZING

Cochrane Multiport Valves provide a system over-pressure regulation that can be relied on. As pressure rises above set pressure, multiple valves ease open and *meter off* the over-pressure. They then gently close to the pre-set pressure, automatically.

Adjustment from zero to required pressure is easily accomplished by hand wheel or chain wheel. Applications are as Atmospheric Relief Valves, Differential Pressure Spill-over Valves for closed systems, Check Valves or as Vacuum Breakers.

Use coupon for complete details

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CORPORATION
3108 N. 17th ST., PHILA. 32, PA.
Representatives in 30 Principal Cities of U.S.A.

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COCHRANE CORPORATION
3108 N. 17th St., Phila. 32, Pa.

Please send me a copy of Publication No. 5200 on Cochrane MULTIPORT VALVES.

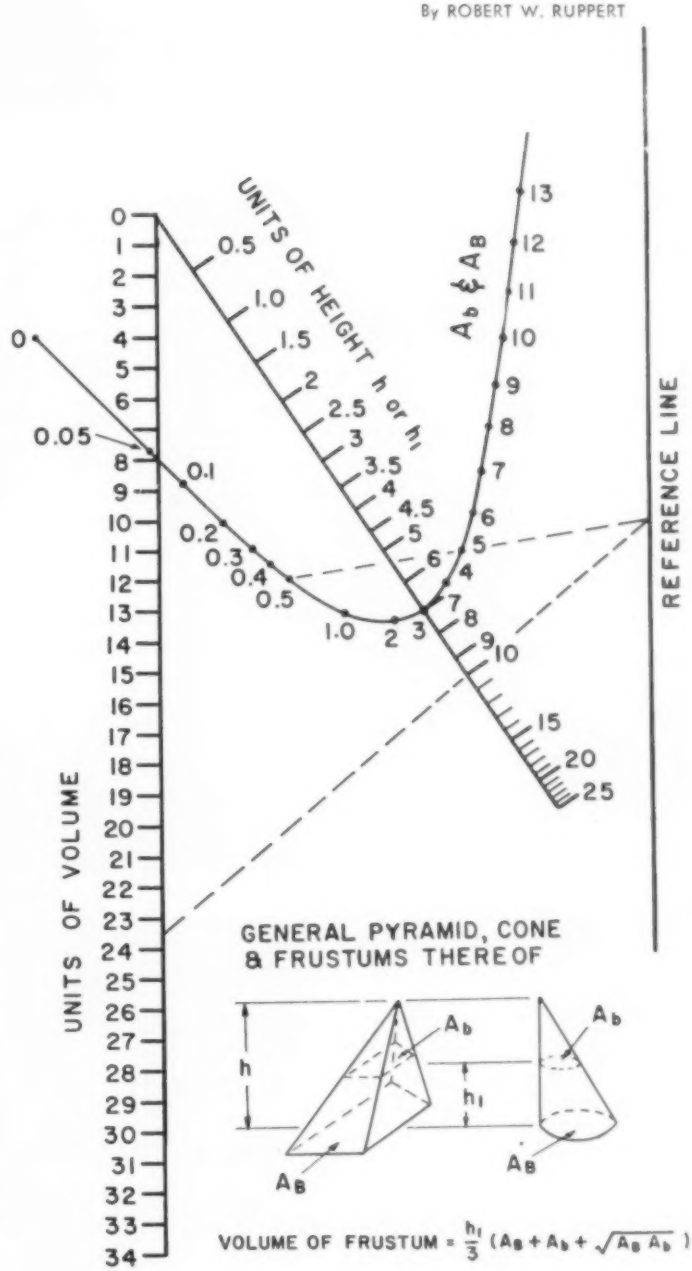
Name_____ Title_____
Firm_____
Address_____
City_____ State_____

Circle 1469 opposite last page.

CUT HERE AND FILE

SIZING HOPPERS

By ROBERT W. RUPPERT



Courtesy of Chemical Processing

Nomograph presented here is a fast way of dimensioning hoppers or of finding capacity of existing hoppers. It is based on an equation pertaining to pyramid and cone-shaped hoppers and it takes into account the truncation of the cone. Volume of hopper can be found by —

$$V = \frac{h}{3}\left(A_B + A_b + \sqrt{A_B A_b}\right)$$

where:

V = volume
h, h_1 = height of cone or pyramid or (see sketch) height of frustum
A_B = area of larger base
A_b = area of smaller base

in any consistent units. Nomograph can be used for full cones or pyramids by using a value of zero for the area of smaller base. Since units are unspecified, problems where solution falls off-scale for feet, for example, can be converted to yards. Final solution, of course, is converted back to desired units.

EXAMPLE: A hopper 10 feet high is to be installed in a space allowing a top area of 5 sq ft. If this is to be a conical hopper with a bottom opening of 0.5 sq ft, what volume will it hold?

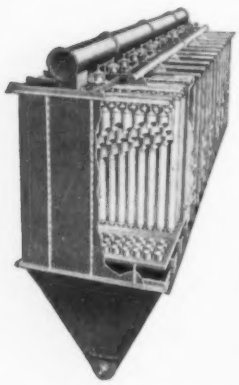
Lay straightedge through points 0.5 and 5 on A_b A_B scale. Locate intersection with reference line. Connect this intersection with 10 on h_1 scale and extend straightedge to volume scale. Note intersection at 23.6 — obviously 23.6 cu ft in this case. ◆

Norblo solves dust problems

Whatever you need in dust or fume control, be sure to check *Norblo*

In Bag Type, Centrifugal or Hydraulic dust collecting systems, Norblo Dust and Fume collection equipment has many design advantages. These three types, frequently used in certain combinations, provide economical dependable control as required in smelting, rock products, chemical, milling and processing fields.

What is the best approach to your dust problems? Norblo helps you select—applies engineering skill and "know how" gained in first hand experience of over 40 years in many industries.



Norblo Bag Type Systems

Automatic and Standard

For continuous or heavy duty service providing very high efficiency at very low cost of operation and maintenance. Basic unit contains 78 bags, 6″ diameter, 8′ 3″ long. Air flow is upward, from inside, thus keeping bags fully distended. Total free cloth area per compartment 936 square feet. Shaking and cleaning controlled by electric timer, is cyclic, one compartment at a time, each having its individual compressed air shaker mechanism and the whole system variable and adjustable for dust load without shutting down . . . Also Norblo Standard Bag Type (non-automatic).

Norblo H. E. L. S. Centrifugal Systems

A cyclone or centrifugal type collector for all materials, from sawdust to fly ash; characterized by high efficiency of collection with low static drop. The Norblo H. E. L. S. has no internal vanes, gadgets or dampers. High efficiency is obtained by scientific proportioning and by the patented (No. 2,259,919) expanding nozzle. These design features eliminate the power-wasting back eddy. Built in standard sizes with capacity up to 37,500 cfm.

Norblo Hydraulic Systems

A high efficiency, wet type collector, for separation of dust mixed with smoke or fumes. In most installations the Hydraulic unit is used with a Norblo Cyclone collector, thus reducing the amount of wet sludge to be handled. No moving parts. Filter beds are coke or high-fired ceramic tubes, light weight and kept in motion by ascending air stream. Beds are self-cleaning. Built in standard sizes with capacities up to 26,000 cfm.

Take advantage of the efficiency and low maintenance available through Norblo Equipment in these three proved systems of dust and fume collection. Write for full information.

The Northern Blower Company
6422 Barberton Ave., Cleveland 2, Ohio • OLympic 1-1300

Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

Circle 1470 opposite last page.

NEW LITERATURE

How to treat feedwater —low-pressure boilers

Data sheet gives tips on maintaining pure feedwater to keep low-pressure boilers operating at top efficiency. Covers corrosion and scale prevention, tube failures, cast iron boilers.

(Two-page Data Sheet LSP 29 is issued by Water Service Laboratories Inc., 423 W. 126th St., New York 27, N. Y.)
Circle 1471 opposite last page.

Seamless pipe, tubing price comparison

Data card gives analysis details and comparative price ratios on 33 seamless stainless grades of piping and tubing with Type 304 (18-8) as base. Two pages.

(Technical Data Card 188 is issued by Tubular Products Div., Babcock & Wilcox Co., Beaver Falls, Pa.)
Circle 1472 opposite last page.

Classified Advertising

complete Anhydrous Ammonia and L.P. Gas plants designed - installed

H. Emerson Thomas & Associates, Inc.

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Save on Your INDUSTRIAL TRACK

FOSTER *QUALITY* **RELAYING RAILS** — FULLY GUARANTEED

Handle more cars better—cost less to install and maintain. Foster stocks all Rail Sections 12# thru 175#, Switch Material and Track Accessories.

SEND FOR CATALOGS

RAILS - TRACK EQUIPMENT - PIPE - PILING

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Classified Advertising

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when you need low cost Electrical Power Equipment—

CHICAGO-ELECTRIC "REBUILTS"

Immediate Delivery!

Fully Guaranteed!

Check this partial listing . . .

MOTORS

SLIP RING

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	MAKE	TYPE	RPM
1200	*A1-Ch.	ANY	1800
600	*G.E.	M-63456	1800
300	G.E.	M-6345Z	1200
250	A1-Ch.	ARY-626J	1800
250	*G.E.	I-M-17A-10	720
200	G.E.	I-M-16	600
200	*West.	CW-950A	514
150	Cr-Wh.	50R	1800
150	West.	CW-874C	720
150	Al-Ch.	ANY	600
125	G.E.	I-M-15A	600
125	*G.E.	I-M-15A	600
100	G.E.	I-M-E13A-4	1800
100	G.E.	I-M-14	900
100	*G.E.	I-M	720
100	G.E.	I-M-15A	450
75	North-W	EW-50	1800
75	G.E.	MT-347-6	1200
75	G.E.	I-M-13	1200
75	G.E.	MT-356-8-75	900
75	Al-Ch.	ANY-33C	720

SYNCHRONOUS MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	MAKE	TYPE	PF	RPM
1420	West.	HG	0.7	900
300	G.E.	ATI-6-285M	0.8	1200
300	*Ideal	SMM	0.8	257
275	*G.E.	ATI	1.0	450
250	A1-Ch.		1.0	1200
225	Elec. Machy		1.0	360
225	G.E.	TS-6244	1.0	300
200	G.E.	TS-7559	1.0	1800
190	Elec. Machy		1.0	720
150	A1-Ch.	SYN	0.8	1200
150	*Elec. Machy		0.8	1200
150	*West.	HR	1.0	300
125	*G.E.	TS-7641	1.0	514
125	*G.E.	TS-6214	1.0	277

MOTORS

SLIP RING — Crane and hoist

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	MAKE	TYPE	RPM
100	G.E.	MTC-5546-8	900
80	G.E.	MTC-5552	600
50	G.E.	HIC	600
35	G.E.	MTC-5536	600
25	West.	CI-636-A	720
15	G.E.	ITC-5009	900
11	West.	CI-E464-A	900
10	P & H	BW-6	1800
5	North-W	WRC	1200

PLATERS

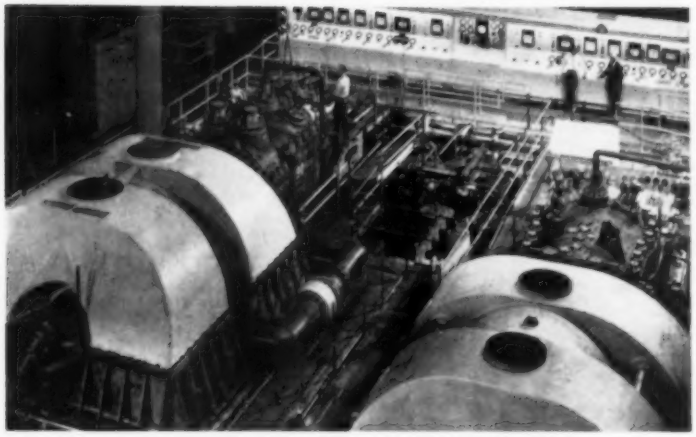
AMPS	MAKE	VOLTS
7500/3750	Elec. Prod	6/12—220/440
7500/3750	Chandy.	12/24—220/440
6000/3000	Chandy.	12/24—220/440
6000/3000	Chandy.	8/16—220/440
5000/2500	Optimus	6/12—220/440
5000/2500	Chandy.	8/16—220/440
1500/750	Chandy.	12/24—220/440
1000/500	Chandy.	12/24—220/440

WRITE OR CALL for complete Stock List
PHONE CAnal 6-2900

CHICAGO Electric Co.

1317 W. CERMAK ROAD
CHICAGO 8, ILLINOIS

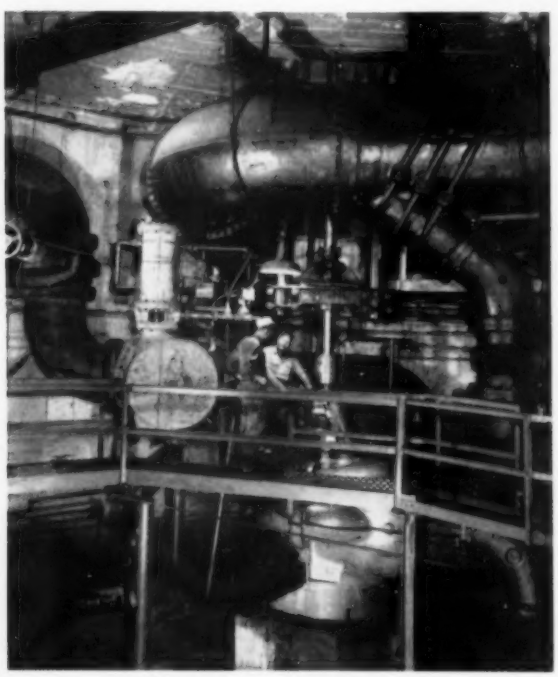
PHOTO NEWS



Under assembly and test at Allis-Chalmers Manufacturing Co., these 150-mw (left) and 100-mw steam turbines feature side crossunders. All double-flow, tandem compound, reheat machines in production will be made with side crossunders.

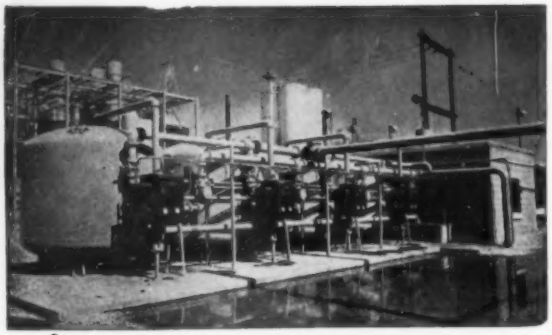
These canned-motor pumps are part of prototype pressurized-water reactor plant that will propel Navy's first nuclear-powered surface vessel. Each of five pumps weighs more than 25,000 pounds and each has a rating of approximately 850 horsepower. Propulsion plant is being designed by Westinghouse for land-based engine under construction at Naval Reactors Facility of the AEC.

Chosen as one of the nation's "Fifty Foremost Business Leaders," Cyrus Eaton (left), major stockholder of Cleveland Electric Illuminating Co., and Kansas City Power & Light, is pictured with Mrs. Philip Sporn, Philip Sporn, president of American Gas & Electric, and Ralph J. Cordiner, president of General Electric (former recipient).



One of two 40-million gpd pumps, recently installed by Dravo Corporation in central pump house of Aliquippa Works of Jones & Laughlin Steel Corp., is tied into plant system. Two-pump addition raises total water supply to 345-million gpd. Water flow (from the Ohio river) is about three times the daily requirement of Pittsburgh.

Engineers of the Bermuda Electric Light Company, Ltd.—in national costume—inspect damage in the public utilities' main control room. Damage resulted from gradual deterioration of insulation on main bus bar selector switch bushings. Fire-protection equipment (eight 100-pound CO_2 cylinders and rate-of-temperature-rise detectors) quenched the fire in minutes.



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(for over half a century)

Complete plants for water softening, demineralization, silica removal, de-oiling of condensate, clarification, de-alkalizing and all other requirements.

Send for Bulletin BFT-11
or Nearest Field Representative.

H&T SERVICE
HUNGERFORD & TERRY, INC.
CLAYTON 1, NEW JERSEY

Circle 1473 opposite last page.

2568

REMOVE MOISTURE *from*

COMPRESSED AIR LINES

Air operated tools, instruments and controls demand air that is

COOL CLEAN & DRY

and the

MURPHY AFTERCOOLER SYSTEM
GUARANTEES IT!

Write now for **FREE** Data Sheet No. 2568.

JAMCO

JAS. A. MURPHY & CO., INC.
1419 EAST HIGH STREET, HAMILTON, OHIO

Circle 1474 opposite last page.

NEW LITERATURE

Finned tubing for −300 to 2000°F

Characteristics and application data on helical and longitudinal finned tubing are given. Includes data on tube or pipe size, tube and fin material, pressure and temperature ranges. eight pages.

("G-R News," (Fall 1957 issue) is available from The Griscom-Russell Co., Massillon, Ohio.)

Circle 1475 opposite last page.

Cleans tubes, pipes quickly, thoroughly

Air-driven and water-driven tube cleaners, accessories, and repair parts for straight and curved tubes, pipes, and transfer lines are described.

(Bulletins J-410 and R-105 are available from Roto Div., Elliott Co., 207 Sussex Ave., Newark, N. J.)

Circle 1476 opposite last page.

Protective wells for thermostat

Complete specifications on wells for thermostats to control fluids and gases for normal or special high-pressure applications are given in bulletin. Maximum working pressures for stainless steel protective wells are 100 psi at 250°F and 60 psi at 600°F. (Two page bulletin MC-158 is issued by Fenwal Inc., Pleasant St., Ashland, Mass.)

Circle 1477 opposite last page.

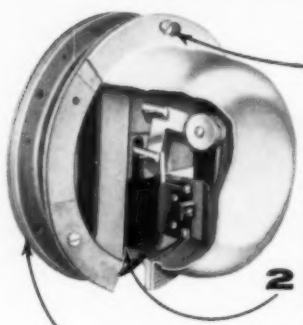
Tape protects cables against fire, acids

Dry cable fire-proofing tape is made of asbestos and silicone for extreme resistance to fire, water, acids, alkalies.

(Bulletin TX-6A, 4 pages, gives test and application data. Johns-Manville Corp., Dept. TX-6A, 22 E. 40 St., New York 16, N. Y.)

Circle 1478 opposite last page.

3 BIG IMPROVEMENTS IN BIN-DICATOR® BIN LEVEL INDICATORS



1 NEW TWIST LOCK COVER

On and off in a jiffy, exposing operating mechanism, by just loosening slotted hex head screws. No nuts or bolts to fumble. Great for hard-to-reach places.

2 NEW VENTED HOUSING

No pressure build-up with flexing of diaphragm. Free action; more sensitive and reliable operation.

3 NEW DRILLED AND TAPPED FRAME FOR ASSEMBLY OF DIAPHRAGM AND RETAINER RING TO FRAME

Here also, change from nuts and bolts simplifies assembly and new diaphragm assembly with perforated mounting holes simplifies replacement or change of diaphragms.

Bin-Dicator, leading bin level indicator for over 20 years, is now better than ever. Write for catalog including data on Roto-Bin-Dicator®, flexible shaft paddle type and Bin-Flo® aerator unit which keeps bulk materials moving. All three offer real plant improvement at very low cost.

THE BIN-DICATOR CO.
13946-V2 Kercheval • Detroit 15, Mich.

Write for detailed literature or call
VAlley 2-6952

WE SELL DIRECT • PHONE ORDERS COLLECT

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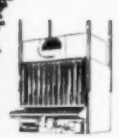
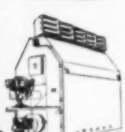
MODERN HEATING FOR INDUSTRY





Reznor direct-fired unit heaters offer the modern solution to industry's heating problems . . . from the guard house or the drafting room to production areas or warehouse space.

Reznor unit heaters cost less to install and less to operate than other types of equipment . . . and they require practically no maintenance.

With suspended, duct and free-standing types in all appropriate sizes from 25,000 to 2,000,000 Btu, the Reznor line includes equipment which is exactly right for your plant heating job.

For complete details, write today for your copy of Bulletin GN-57 or give your nearby Reznor distributor a call. You'll find him listed under "Heaters-Unit" in the Yellow Pages.

REZNOR
WORLD'S LARGEST-SELLING DIRECT-FIRED
UNIT HEATERS

Reznor Manufacturing Company, 70 Union Street, Mercer, Pennsylvania

Circle 1480 opposite last page.

Steam rate nomographs turbogenerator data

Steam turbogenerators in medium capacity range are designed for electric utilities, metals reduction plants, pulp and paper mills, and petrochemical installations.

Bulletin gives data on reheat or non-reheat condensing turbines; single, double, and triple automatic extraction turbines; admission units; admission-extraction steam turbines. Two nomographs aid in calculating steam rates.

(Bulletin GEA-3277D, 54 pages, is issued by General Electric Co., One River Road, Schenectady 5, N. Y.)
Circle 1481 opposite last page.

Interchangeability chart variable transformers

Interchangeability chart gives equivalent data on type, number, and output amperage of variable transformers — three major variable transformer lines. Chart covers both manually operated and motorized transformers.

(Four page chart is issued by Standard Electrical Products Co., Dept. A5, 2240 E. Third St., Dayton, Ohio.)
Circle 1482 opposite last page.

Mechanical specs on rotary valves

Describes Style A rotary valves for continuous discharging or feeding of dry, free-flowing bulk materials. Includes complete dimensions, specifications, and capacities. Two pages.

(Bulletin N-578 is by The Day Co., 810 Third Ave., N. E., Minneapolis, Minn.)
Circle 1483 opposite last page.

Reviews tachometers for every application

Tachometers described include portable, permanent, centrifugal, chronometric, and vibrating-reed types. Tachometers are available in rpm and surface-speed types with ranges from 30 to 48,000 rpm and from 5 ft/min to 2400 ft/min.

(Bulletin 1048, 4 pages, is issued by Herman H. Sticht Co., Inc., 27 Park Pl., New York 7, N. Y.)
Circle 1484 opposite last page.

Water treatment systems for process, feedwater

Ion-exchange water treatment systems for process water, boiler feedwater, product purification, and clean discharge water are described in bulletin. Includes custom-designed deionizers, demineralizers, dealkalizers, softeners, and filters.

(Six-page bulletin is issued by H. M. Mueller Corp., 3340 Gorham Ave., Minneapolis 26, Minnesota.)
Circle 1485 opposite last page.

Engineering data for flexible coupling

Bulletin describes flexible cushion coupling with flexing body that automatically compensates for angular and parallel misalignment, end float; absorbs torsional vibration. Gives complete selection and application data.

(Bulletin A-669 is by Dodge Manufacturing Corp., Mishawaka, Ind.)
Circle 1486 opposite last page.

How to build with expanded metal

Bulletin illustrates use of expanded metal for plant construction and maintenance. Includes sizes, air flow tables, and load capacities. Expanded metal, now in four new patterns in addition to the standard diamond shape, comes in carbon or stainless steel and aluminum.

(Bulletin 20-4 is issued by Joseph T. Ryerson & Son, Inc., Box 8000-A, Chicago 80, Ill.)
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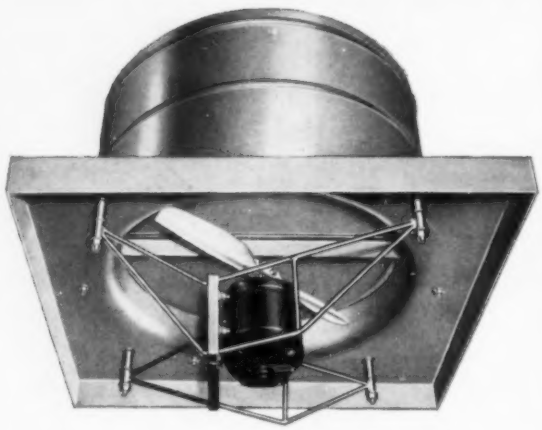
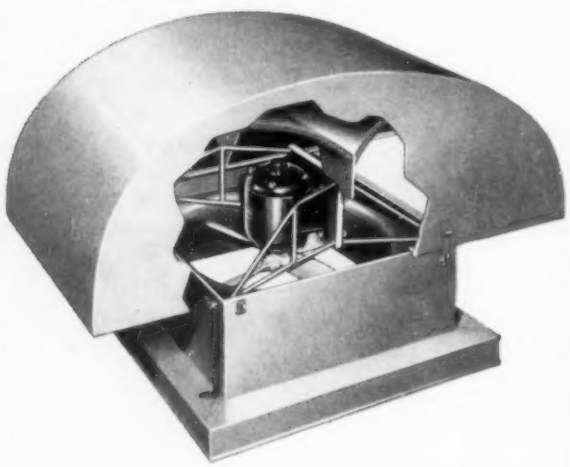


HARTZELL VERTIJET — Windband formed from 20 gauge galvanized steel, base from 14 gauge zinc-grip coated steel. Fan ring is integral part of base sheet. Two semicircular galvanized lids at base of windband open automatically when fan goes on, close weather-tight when it goes off. Throat sizes from 18" to 60"



HARTZELL REVERSIBLE ROOF VENTILATOR—One unit does the job of two conventional one-way ventilators. This unit moves air in either direction with equal efficiency; you convert from intake to exhaust at the flick of a switch. Throat sizes from 28" to 44".

Why You Can Count on Hartzell Air-Moving Equipment for Long Life, Rugged Reliability and Minimum Maintenance

Hartzell fans and blowers are engineered and built for the exacting requirements of tough industrial service. There's no compromise with quality for the sake of shaving a few dollars on price. Hartzell fans are designed for the industrial buyer who is willing to pay for long life, dependable service and low maintenance.

Design Simplicity OF HARTZELL *roof ventilators means...*

HIGH EFFICIENCY...

These Hartzell roof ventilators expel large volumes of heat, smoke and fumes quickly and efficiently because simplified design reduces obstructions to air flow. There's no maze of interior braces and supports. And all Hartzell roof ventilators are tested for performance in accordance with Standard Test Codes of the American Society of Heating and Air Conditioning Engineers.

LOW INITIAL COST...

Elimination of complications of design and construction produce savings in production costs which are passed along to you. Hartzell design simplicity means that Hartzell roof ventilators can offer top quality construction for long life and dependable service at a price much lower than that of more complex designs.

MINIMUM MAINTENANCE...

By minimizing the number of moving parts Hartzell reduces the number of things that can go wrong. Lids on vertical discharge models are mounted on corrosion resistant brass rods which turn on heavy Micarta plastic bearings which require no lubrication... won't stick, won't rust. Fan motors are ball-bearing type, conservatively rated for continuous performance. Under normal operating conditions, the only maintenance required will be periodic motor lubrication.

Write today, or ask your nearby Hartzell field engineer for a copy of the free Bulletin A-112A. It contains all the specifications for the two roof ventilators pictured, as well as for Hartzell's Airjet, Rotary and Penthouse roof ventilators.

HARTZELL
PROPELLER FAN CO.
Div. of Castle Hills Corp.
202 Thomas Blvd. • Piqua, Ohio

ENGINEERING OFFICES IN PRINCIPAL CITIES

Circle 1488 opposite last page.

Financing the Future
← *from page 19*

to be sold, and poor judgment of other market factors may take years to correct, and perhaps can never be corrected. Hence, raising new capital is a most vital and difficult responsibility of utility management.

Financial management will continue to be a monumental task, and one of great importance in the vast undertakings that are ahead. Perhaps today there is no single area in the utility business that, in the final analysis, will benefit customer and investor alike more than the successful financing of our future growth. And I would like to say here that great credit is due our financial people. I might add that recognition is long overdue for their outstanding accomplishments and unusual skill in handling the financial difficulties we have so successfully overcome.

The electric industry can look back to a record unmatched in growth, in great technological achievement, and in meritorious service to the public. In the short span of a lifetime, our industry has helped bring about revolutionary developments in science, in industry and commerce, and in the living standards in every American home. Today, we stand foremost among the great nations of the world. It is perhaps no accident that, as a nation, we are in the forefront as a producer and consumer of electric power.

We in the utility business expect to continue to build ahead of America's growth—in the van of our forward-moving economy. Our country is constantly changing. These changes are stimulated and guided by the flow of capital funds into the economic stream. These funds come from countless individuals putting their savings to work for their own future and pooling them in America's productive machine. And we, in the utility industry, have the responsibility to insure that our business remains sound and financially healthy, so that we will be able to attract our proper share of these capital funds. ◆

THAT'S INTERESTING

She's hot

Ordinary motion picture projection equipment is part of technique that concentrates rays from a carbon arc into a high-energy beam that produces temperatures above 7000 F. Technique is used in high-temperature studies at National Carbon Co.'s research laboratories. Beam can be projected through controlled atmosphere in transparent vessel to study effects of high temperatures and pressures.

Monster

Trane Co.'s fluid cooler provides 12,000 gpm cooling water for Oak Ridge National Laboratory's new nuclear research reactor. Eight-cell cooler removes 68 million Btu-hr — enough heat for 900 homes.

For more information on product at right, circle 1489 see information request blank opposite this page.

The Yarway Impulse started a new era in steam trapping...

. . . it began in 1935, when Yarway applied a unique principle of thermodynamics to steam traps—and the Yarway IMPULSE Steam Trap was born.

Since then over 1,225,000 Yarway IMPULSE traps have proved themselves so well in service that today many other type traps are regarded as obsolete—an understandable reason why the Yarway IMPULSE type of steam trap is being imitated.

To industry, the Yarway IMPULSE trap makes possible a new high in thermal efficiency of equipment, a new low in trap operating maintenance . . . resulting in increased production and higher profits.

THE THERMODYNAMIC PRINCIPLE

This is the principle on which the Yarway IMPULSE trap design is based—that variations in temperature of water discharging through two orifices in series cause variations in pressure in an intermediate chamber between the orifices, and that these changes in pressure may be utilized to open and close the trap valve.

ONE MOVING PART

There is only one moving part in a Yarway IMPULSE trap—a small, stainless steel valve. The entire valve assembly can be replaced in 5 or 6 minutes. It is the simplest of all steam traps to service.

EQUIPMENT HOTTER, SOONER—STAYS HOT

At "start up" the little valve opens wide to discharge air and condensate continuously. This brings equipment into production in the quickest possible time. The valve then actually floats on the condensate load, maintaining highest, steady temperatures.

A YARWAY IMPULSE STEAM TRAP TO MEET EACH TRAPPING REQUIREMENT

Research and development in the Yarway Steam Laboratory, plus intensive field testing, have produced a line of steam traps—*all* of the Yarway IMPULSE type . . . to efficiently meet each of the following classes of trapping service:

Normal requirements for pressures up to 600 psi call for Yarway Series 60 and 120 IMPULSE Traps in six sizes, ½" to 2".

Light loads for pressures up to 600 psi call for the ½" Yarway No. 20-A and No. 120-A IMPULSE Traps.

Heavy loads for pressures to 600 psi call for the extra high capacity Series 40 Yarway IMPULSE Trap, available in five sizes, ½" to 2½".

Highest pressure and marine requirements up to 2500 psi are met by the Yarway Integral-Strainer IMPULSE Trap, in six sizes, ½" to 2", flanged, screwed and socket weld types.

PLUS ADVANTAGES

- Small size and light weight
- Easy, low cost installation
- Minimum maintenance
- Non-freezing
- Stainless steel construction
- No adjustment of valve or seat needed for any pressure
- Low initial cost

NATIONALLY STOCKED, SOLD AND SERVICED

Over 270 Industrial Distributors stock and sell Yarway IMPULSE Steam Traps . . . and over 35 Yarway field engineers are available to help you select the right steam trap for the job.

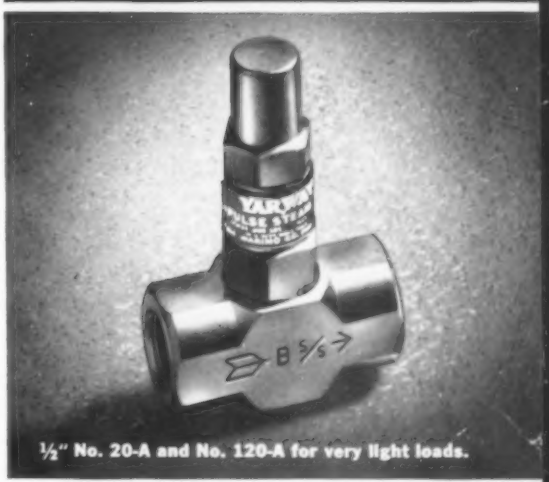
Write for free, new bulletin "*The Why and How of Steam Trapping.*"

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY *impulse*

...a good way to specify steam traps

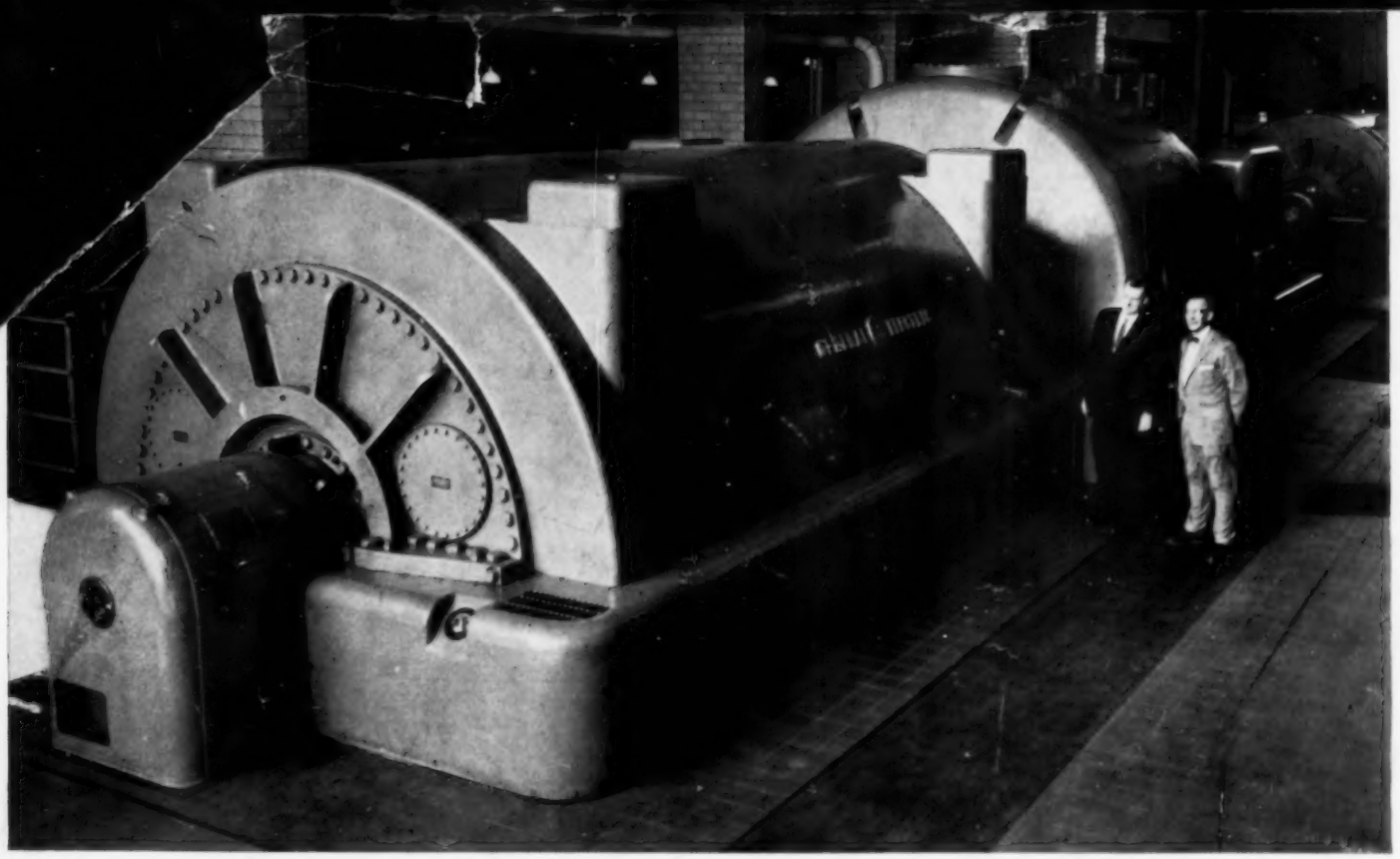
Series 60 and 120 for normal requirements.



½" No. 20-A and No. 120-A for very light loads.

Series 40 for very heavy loads.

Integral Strainer Impulse Traps for highest pressures and marine use.



This new 70,000 kw reheat turbine—like all other turbines in this plant—is 100% Texaco-lubricated to keep it free from rust, sludge and foam.

A large Eastern Utility found:

Texaco gives these 3 big benefits for complete turbine protection:

1. Unquestionable dependability. Texaco Regal Oil R&O keeps the utility's turbine system clean; prevents rust, sludge and foam from forming; keeps bearing temperature normal and governor response instantaneous. Texaco dependability is a *fact* for this utility, based on long experience.

2. High efficiency. Texaco Regal Oil R&O assures smooth performance and freedom from unscheduled outages. Texaco Regal Oil R&O gives bearings full protection throughout an extra-long oil service life.

3. Technical service. Texaco offers this important benefit at a time when power demands are almost out-growing turbine production. Past experience in the power plants has proved Texaco Lubrication Engineering Service to be quick and reliable. This service is always available to Texaco customers—whatever the need.

There is a complete line of Texaco Regal Oils R&O to meet the requirements of all leading turbine manufacturers, regardless of turbine type or size. Let a Texaco lubrication expert help you select the Texaco Regal Oil R&O that will keep turbine efficiency high and maintenance costs at a minimum. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States—or write:

The Texas Company, 135 East 42nd Street, New York 17, New York.

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LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

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